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Cooling Wind Control for Glass Forehearths

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• THIS PAPER DESCRIBES A pneumatic method for automatically controlling cooling wind on the channel of a glass forehearth. The method has proved successful on a Hartford Empire Type 81 forehearth at the Diamond Glass Company, Royersford, Pa. This forehearth has type KW firing and 6-inch depth of glass, and it feeds flint container glass to the forming machine.

The installation shows that the automatic control system has many advantages over the manually operated system. These advantages include:

1. Maintenance of the glass temperature at the desired value.
2. Less fuel consumption.
3. Rapid stabilization of temperature after a job change.
4. Release of operators from making manual adjustments.
5. Provision of controlled amount of side channel heating.

These technical advantages show that the system provides three important benefits: economy, higher quality glassware, and increased production.

Forehearth Operation

"Cooling wind" refers to the air that is blown into the cooling section of the forehearth channel superstructure. Wind is needed to cool the glass if its temperature exceeds that required for the forming machine. In bottle manufacturing, batch is melted and fined to a temperature that is generally several hundred degrees hotter than the final temperature of the gob delivered to the forming machine. During the flow of glass, excess heat is brought into the channel, and cooling wind is usually necessary to reduce the glass temperature.

The conventional forehearth design with its heating and cooling control systems is shown in Fig. 1. Note that a fan is provided to supply the cooling wind. An adjustment screw moves a lever to simultaneously operate a small butterfly valve in the cooling wind duct and a damper brick over a chimney in the forehearth superstructure. There may be two to five of these adjustments on one channel, depending on the length of the forehearth.

Temperature in the cooling zone is sensed at the downstream end by a radiation pyrometer. The longer forehearths may be divided so that there are two temperature sensing devices in the channel, each with a corresponding fuel header. Firing is automatically controlled, in accordance with the measured temperature, by the control instrument which delivers a pneumatic signal to operate a valve in the conventional air-fuel system. In the usual system the instrument—a potentiometer-controller—controls only the fuel-air input to the burners. Cooling wind is manually set as required to bring the temperature controller into effective range. Warning lights are provided to show the operator that the firing control valve has approached the high or low limit of its travel.

In the conditioning zone the glass temperatures are equalized, so there is minimum gradient from top to bottom of the glass, before the glass is discharged from the orifice. Temperature is sensed at the end of this

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zone just before the spout. A fuel header, separate from the cooling zone header, supplies fuel to the burners in the conditioning zone and around the spout. Firing is automatically controlled by an instrument identical to the one controlling the firing of the cooling zone.

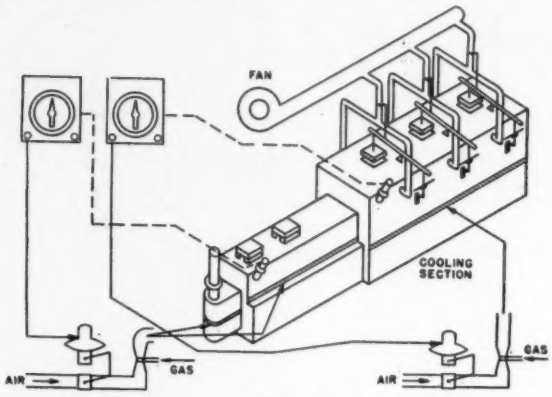


Fig. 1

Temperature control and cooling wind adjustment is most difficult during job change startup. As gob size and shape are adjusted to obtain the proper gob, the dampers must be frequently adjusted. Major adjustments are made in the first hour, and after that occasional adjustments are required until conditions stabilize. Ambient temperatures also have a pronounced effect on cooling requirements.

Even under relatively stable conditions, proper control is not easily obtained. For instance, if insufficient cooling wind is left on, glass temperature rises above set point, even though the fuel valve is in its minimum position. On the other hand, if excessive cooling wind is left on, excessive fuel is consumed to reheat the glass and overcooling is possible if the heating control gets out of range.

Automatic Control System

It is obvious that the number of factors involved with the manual cooling wind control make the adjustments heavily dependent on a thoroughly experienced operator. The automatic cooling wind control system overcomes the disadvantages of the manual control. A separate pneumatic controller, operating from the existing temperature controller, is the chief component in the automatic system. Such a controller meets the requirements for system operation, and it has the following advantages:

1. It is flexible in its adjustment of both heating and cooling action.
2. It operates in conjunction with existing standard pneumatic forehearth control systems.
3. It uses the full 3-15 psi control signal for cooling action and permits the continued use of this full signal for heating control. This affords maximum sensitivity which is essential for close control.

Description of Control System

The arrangement of the automatic cooling wind system is shown in Fig. 2. The following items are controlled by the system: the fan motor switch, the butterfly valves, and the damper blocks.

Each butterfly valve and its corresponding damper block remain interconnected, as on the manual control. To control these items there are only four components that need be added to the existing temperature controls. These components are: a separate indicating controller, two air motors to operate the dampers and butterfly valves, and a pressure switch (range 0-15 psi) to operate the fan motor.

Operation of Control System

The cooling wind control system utilizes the output signal of the existing Honeywell electronic temperature controller for its control signal. If glass temperature increases or decreases from the set-point temperature, the pneumatic output signal of the existing heating controller goes to the combustion air valve and simultaneously to the cooling wind controller.

The cooling wind controller uses this same signal to provide its own controlled output signal to the air motors, which actuate the dampers and butterfly valves. The function of the controller is to properly apply cooling wind so the desired minimum amount of heating is required from the burners. With this control system the cooling wind is automatically controlled just as it would be manually controlled by an expert operator who could devote full time to making adjustments.

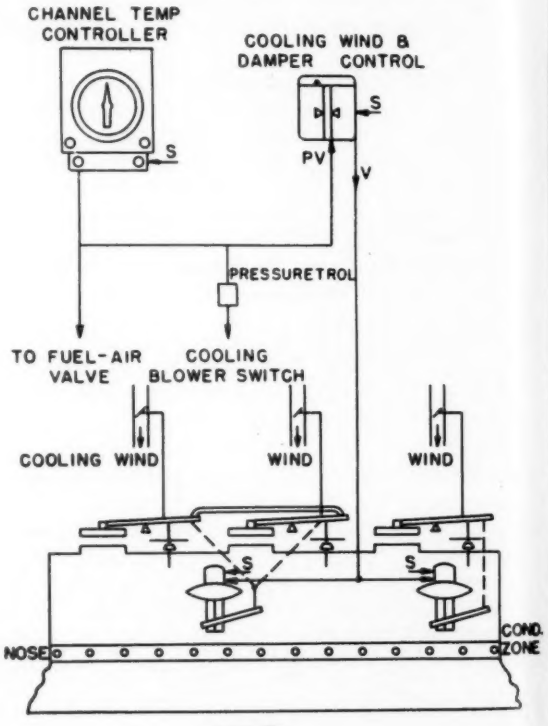


Fig. 2

In the case where the glass temperature is too high, the fuel supply is decreased, and the cooling wind controller slowly opens the dampers and butterfly valves just enough to cool the glass to the desired temperature. Overcooling does not occur. When the flowing glass requires continuous but variable cooling, the burners

consume a preset minimum amount of fuel, regardless of the amount of cooling wind required.

In the case where temperature is too low, the heating control increases the fuel supply in order to raise the glass temperature. At the same time the cooling wind controller gradually closes the dampers and butterfly valves. No more heat than necessary is applied because the cooling wind has been automatically reduced to balance the heating requirements. It is obvious that when the lower limit of the cooling wind adjustment is reached, the heating control will continue to change fuel supply in order to maintain the desired glass temperature. When a high fuel supply is required, the cooling wind fan is automatically shut down. The fan is shut down by a Honeywell pressure control switch which is operated from the output air signal of the heating controller. There is a differential setting in the pressure switch which starts the fan before the fuel has been reduced to a value that requires opening of the cooling dampers; this prevents cycling of the fan.

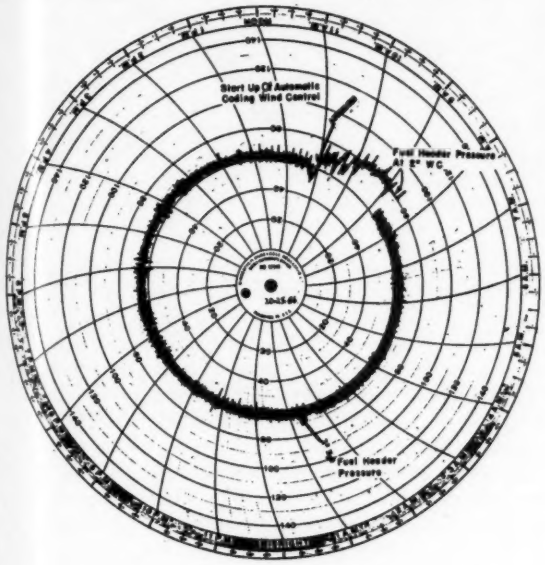


Fig. 3

When cooling wind is on the cooling wind controller in effect controls the fuel header pressure. This effect results from maintenance of the combustion air valve at its preselected minimum position by regulation of the amount of cooling supplied. Because of this effect, the setting of the set-point index on the cooling wind controller establishes the fuel header pressure when cooling wind is applied. Fig. 3 is a chart record of the signal to the combustion air valve. Note that when the control was switched to automatic operation how closely, and to what a low value, the header pressure was maintained.

The cooling wind controller, which is a Honeywell indicating control unit, has its own easily adjustable set point. A view of this controller is shown in Fig. 4. Because the cooling wind controller is compact and suitable for panel mounting, it can be installed on the panel close to the existing heating controller. All of the operators' adjustments, including the set-point index, can be made from the front of the panel. The controller permits manual operation of the cooling wind from the

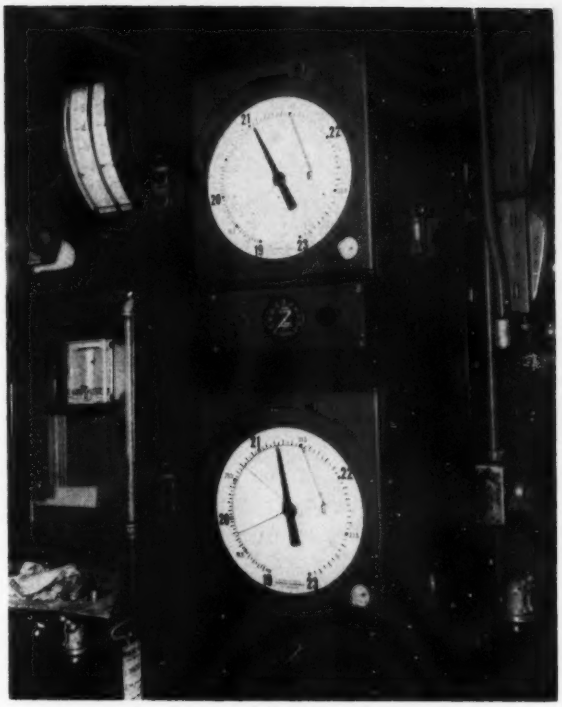


Fig. 4

instrument during startup or maintenance. Control can be smoothly transferred to automatic operation by turning a lever. Automatic action of the controller is very gradual to simulate the best manual damper adjustments.

The optimum minimum header pressure, as established in effect by the adjustable set-point index on the cooling wind controller, should be about 1 inch of water on a typical forehearth where pressure can be varied between ½ and 6 inches. This pressure maintains a certain amount of flame above the glass and helps prevent a skin from forming on the surface. The judgment of the operators, who can tell how well the top and bottom glass is moving, should be used for determining whether 1 inch of water is the best pressure for minimum flame.

By slowly and continuously readjusting both cooling wind and heating, the system maintains the desired heating to prevent overcooling the glass near the channel sides. This dual, but independently adjustable control action causes the combustion air valve, and consequently fuel header pressure, to return to its preset optimum setting when cooling wind is on. Because the controller is separately adjustable, it meets the requirements for cooling wind and damper movements which are different than the requirements for heating control.

Damper Operating Mechanism

For operating the butterfly valves and dampers, the springless air motors are mounted beside the channel so that adequate linkage motion can be obtained, as illustrated in Fig. 5. The damper motors are arranged so that the two dampers farthest away from the spout are operated by one large motor. The third damper, nearest the spout, is operated by one small motor. All of these air motors are actuated by the same pneumatic

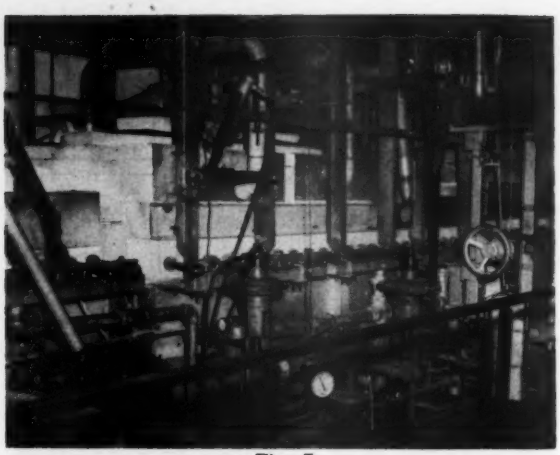


Fig. 5

signal, from the cooling controller. Single operation of the damper nearest the spout is desirable because the Radiamatic unit is next to this damper, and greater sensitivity of control at this location provides even temperature.

The dual damper arrangement has a triangular strap bracing connected to the air motor linkage to insure even operation of the two dampers. The rear dampers can be adjusted to be more open than the other, and can be set to have more movement if desired. It was found that although damper travel of four inches was provided on the forehearth, a travel of about three inches was adequate for automatic control purposes.

Conclusions

The automatic cooling wind control, now in its second year of continuous operation, has proved its dependability.

The system permits the temperature controller to "line out" quickly after a job change, or set point change, as shown by Fig. 6. For a set-point change, the total time for line out is less than five minutes for a ten degree shift, and less than ten minutes for a twenty degree shift. The reduction of time for stabilization of temperature after job change will assist in obtaining a higher gross pack.

Chart records show excellent temperature control lines, continually as good or better than when the dampers were manually set at their best position.

Savings in fuel consumption result from the maintenance of minimum fuel when cooling wind is required.

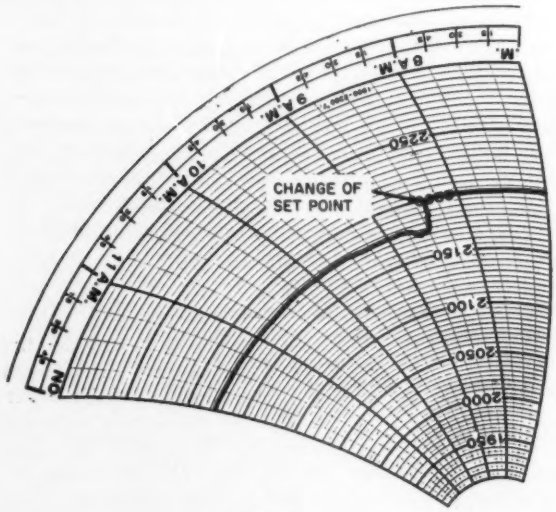


Fig. 6

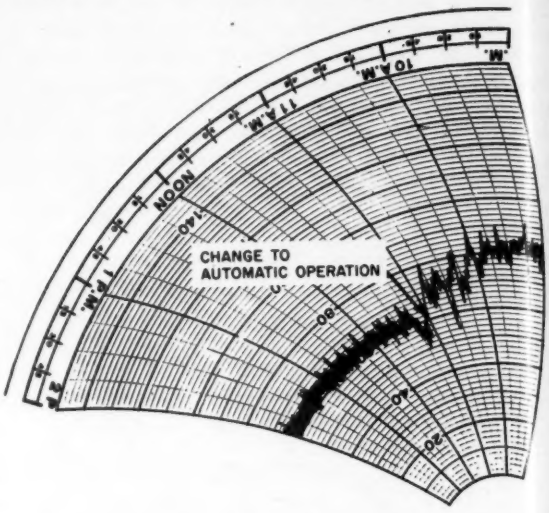


Fig. 7

The set point for fuel is easily adjustable to suit operating rates. The range of adjustment on the test installation was varied to provide from ¾ to one inch fuel header pressure. Both of these settings are below the average for manual damper control. Fig. 7 shows a typical example of the uniformity and lower level of firing (valve position) when automatic cooling wind control is applied.

The cooling wind control is easy to adapt to a standard pneumatic channel temperature controller. Installation can be made at any time without operating delay.

C. G. BIGELOW, JR. APPOINTED RESEARCH DIRECTOR AT SELAS

Frederic O. Hess, president, Selas Corporation of America, Dresher, Pa., announces the appointment of C. Glen Bigelow, Jr., to the newly-created position of director of research.

Mr. Bigelow's background, which includes specialization in the building of heavy industrial furnace equipment, as well as automatic heat treating machinery, is ideally suited to meet the expanding research needs of the process engineering company.

He comes to Selas from American Machine and Foundry Company, where since 1951 he has served as technical director of the General Engineering Laboratories in Greenwich, Conn., and more recently as new products secretary in the firm's New York City headquarters. He was also previously associated with Loftus Engineering Company, Pittsburgh, Pa., as assistant chief engineer and with U.S. Gypsum Company as research engineer at the Building Materials Research Laboratories located in Chicago.

Notes on the Optical Society Meeting

• THE SPRING MEETING OF the Optical Society of America was held at the Sheraton Park Hotel, Washington, D.C., March 27, 28 and 29.

On the two preceding days, the Inter-Society Color Council held its meeting and those Optical Society papers that dealt with color were scheduled for Thursday, the 27th, for the convenience of those persons belonging to both organizations.

Fifty-nine papers were presented during the three day session. The following notes cover only those papers and activities considered to be of most interest to the glass industry.

Infrared Polariscope

A. V. Appel and D. A. Pontarelli of the Armour Research Foundation Laboratory described an instrument for the photoelastic stress analysis of semiconductor material. The instrument operates in the 1.1 to 1.2 micron spectral region. The specimen is located in a collimated beam and holds samples of diameters up to 40 millimeters. By means of a rotating mechanical stage, lateral displacement of the specimen is introduced in two mutually perpendicular directions in a plane at 90° to the optical axis. Residual and induced stress patterns may either be viewed on the screen of an infrared image converter tube or photographed. A calibrated mechanical load system is used to stress a specimen under test.

Oscillatory Magneto-Absorption of Radiation in Semiconductors

An excellent invited paper by Solomon Zwerdling of the M.I.T. Lincoln Laboratory described this new phenomenon which has been observed in germanium, indium arsenide and indium antimonide. According to the theory, quantized magnetic electron energy levels are created in semiconductor valence and conduction bands. If photons of energies greater than the forbidden energy gap are incident on the material, electron transitions will take place between respective pairs of valence and conduction levels. At what Dr. Zwerdling calls the "tail" of the absorption edge this transition becomes oscillatory. In early experiments on germanium, indium arsenide and indium antimonide, accurate values were obtained for the energy gap and reasonably good estimates of the effective electron mass. It was also found that the effect was anisotropic. The most recent experiments were made with germanium samples in a specially constructed cryostat in a magnetic field of 38.9 kilogauss at temperatures of 77°K, 4.2°K, and 1.5°K.

Miscellaneous Technical Developments

A multilayer interference filter with a half width of less than IA was discussed by Alfred E. Mann and Frank C. Rock of Spectrolab, Inc. Unfortunately no technical information on the composition of the filter was announced since the authors were still engaged in patent application.

Zinc sulfide has been found to have very excellent reflection properties in the extreme ultraviolet. J. T. Cox, J. E. Waylonis and W. R. Hunter of the U. S. Naval Research Laboratory have made films with reflections of 19 per cent at 900A, 26 per cent at 1105A and 31 per cent at 1216A. Further, in contrast to aluminum, whose reflectance decreases rather rapidly during exposure to air as a result of oxidation, the zinc sulfide showed no signs of aging during 19 months air exposure.

The optical constants of evaporated selenium films have been determined over the wavelength region 0.23 to 2.5 microns by W. F. Koehler, F. K. Odencrantz and W. C. White of the U. S. Naval Ordnance Test Station.

Some of the Russian satellite instrumentation for solar radiation measurement was described by H. Friedman of the U. S. Naval Laboratory. Descriptions and photographs of equipment carried in Sputnik II have have been released by the Soviet embassy.

George R. Harrison of M.I.T. announced the ruling of three plane diffraction gratings having ruled widths of more than 10 inches on the new interferometrically controlled M.I.T. ruling engine. Resolving powers of 750,000 in the 12th order of 5461A, greater than any previously claimed, were described. Resolving powers of 1,400,000 have been measured at 2537A in the 26th order. Rowland ghosts intensities have been reduced to negligible values and satellite intensities are below 2 per cent total.

A new integrating sphere type of spectroreflectometer was described by Frank Kelly of Beckman Instruments for measurements in the ultraviolet, visible and near infrared regions. Interchangeable sources and detectors are utilized.

General

The Adolph Lomb medal for 1958, awarded to the most outstanding man in optics under the age of 30, was awarded to Dr. Edward L. O'Neill of Boston University. Dr. O'Neill has done outstanding work in the theoretical study of sine wave response in optical systems.

Dr. Wallace Brode, newly appointed science advisor to the Secretary of State, discussed briefly his responsibilities and his broad goals. Dr. Brode has already begun reviving the former practice of maintaining science attaches in the leading American Embassies abroad. It will be his responsibility to keep the Secretary of State abreast of current scientific activity both in the United States and overseas.

The featured dinner speaker was Dean George R. Harrison of M.I.T., substituting for Dr. William F. Meggers, the originally scheduled speaker, who unfortunately was ill. In an amusing talk titled "My Life with William Meggers, or Our Hearts were Young and Gay" Dr. Harrison reviewed some of the high points of his lifelong friendship with Dr. Meggers.

N. A. FINKELSTEIN

Plate furnace under construction.

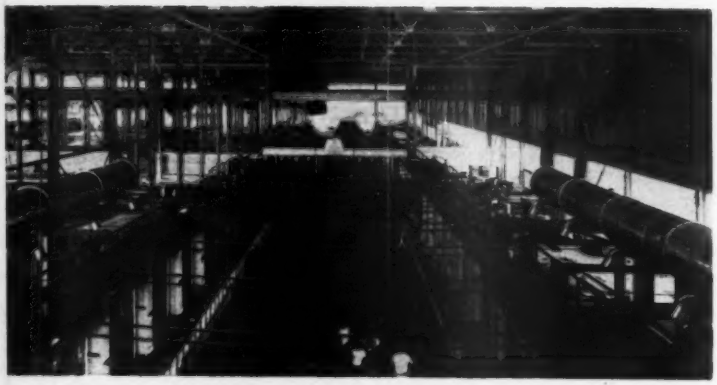
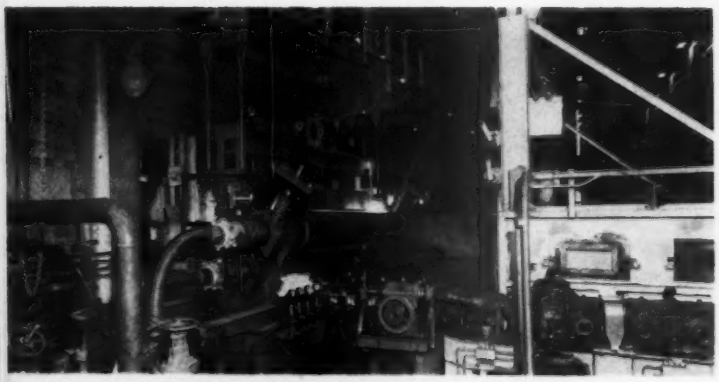


Plate furnace under construction.

Plate furnace under construction, machine end.



Rolling machine of plate furnace at start-up.

Ford's New Nashville Glass Furnaces

By K. C. CARNES, Vice President,
Toledo Engineering Company, Inc.

• FORD MOTOR COMPANY'S NEW glass plant at Nashville, Tennessee has been in production for about a year. From the outset, extremely gratifying results have been obtained in all phases of plate and sheet glass operations which were greatly accredited to the glass melting furnaces.

The plant contains two large side fired regenerative furnaces. One for melting plate glass and the other for sheet glass. Each furnace has six ports which are fired with natural gas. Propane is used as a standby fuel.

A prerequisite in designing these furnaces was to make them as modern and efficient as possible so that the highest quality of the glass and lowest production costs could be constantly maintained.

With this in mind, Toledo Engineering Company engineers working closely with Ford engineers started the original layouts of the heart of the plant, namely, the "hot" end. By the summer of 1955, the basic building and foundation designs for the tanks, glass machines and lehrs were formulated.

Following this, design of the two furnaces with their auxiliary equipment was then finalized and materials were purchased. Construction of the furnaces was started in May 1956. The plate furnace was completed and put into operation in December of the same year and the sheet furnace was completed and started in March 1957.

Illustrations shown throughout this article will acquaint the reader with the approximate size of both of the furnaces.

In construction, these furnaces have box-type regenerators with single chambers. The melting and refining end crowns are supported by straight-through heel plates thus eliminating inverts or other means of supporting refractories from port entrances into furnace crown. Both fur-

Light up of plate furnace. From left, L. O. Seltz, plant manager; Mrs. Seltz; and Mr. P. Campbell.

naces are equipped with suspended refractory curtains which separate the melting end from the refining end. Operation of the furnaces are fully automatic using the most modern methods of electronic, mechanical and hydraulic instrumentation. Chimneys are of the natural draft type and extend 200 ft. above grade.

Approximate proportions of these furnaces are as follows:

	Plate Furnace	Sheet Furnace
Width—inside of tank blocks	28′	28′
Length—inside of tank blocks	150′	117′ *
Depth of tanks	4′	4′
Tons of glass in tank	1288	1000 *
Number of ports	6	6
Regenerator area inside each chamber	770 sq. ft.	620 sq. ft.

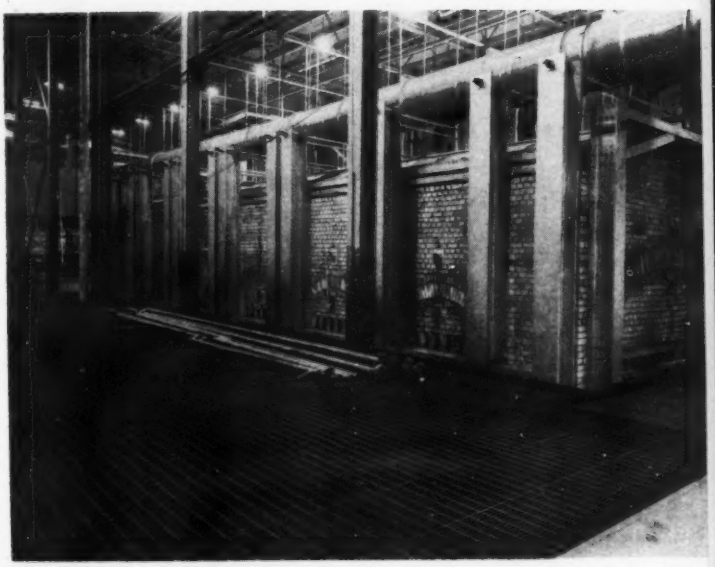
* Not including length of cooling or drawing chambers.

The plate furnace is equipped with a continuous rolling machine. The molten glass is constantly supplied to this machine and the width of the rolled glass ribbon as it enters the lehr is about 130 inches. Glass is supplied to the machine by a short spout connected to the refining end on the center line of the furnace. Amount of glass to be rolled depends on the width and thickness of the ribbon and the speed of the machine. Water cooled skim bars and hairpin coolers, made from high chrome-nickel alloy steel, are used in the refining end of the furnace to assist conditioning of the glass before entering the spout. A vertical shut-off gate is installed on the spout structure to stop flow of glass from spout to machine in event of machine repairs or for other reasons that may necessitate stoppage of glass flow.

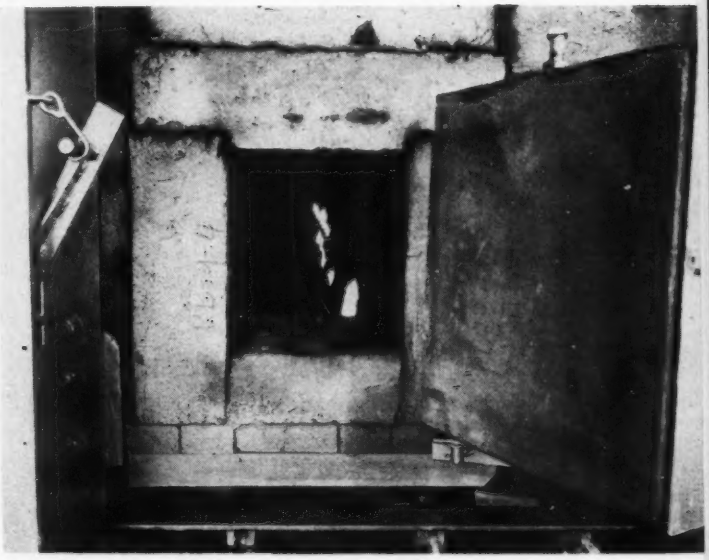
The sheet furnace has two glass drawing machines. The glass ribbon from each machine enters its own horizontal lehr. The width of each glass sheet is about 120 inches. To get the conditioned glass to the machines, it flows from the refining end of the furnace through two canals. Each canal has its own cooling and drawing chamber to supply glass to each machine. Water cooled skim bars and hairpin coolers are used in the canals. Provisions are also made for additional cooling by water cooled alloyed bars in the cooling chamber sections. The drawing chamber section consists of a clay drawing pot supported on a heated chamber so that

Melting end of plate furnace.

Regenerators of plate furnace at start up.



Regenerators of plate furnace.



Melting end door of plate furnace during heat up.

View of bottom steel of sheet furnace under construction.

the temperature of the underneath surface of the pot can be carefully controlled.

When it is required to replace a drawing pot on a hot furnace, the pot must be pre-conditioned and pre-heated to a certain temperature to prevent cracks or breakage due to shock caused by the hot glass flowing on the new pot. A very unique system of replacing pots together with their own individual pot chambers was installed for this particular operation. The system consists of four pot chamber heating ovens which heat both the pot chambers and pots simultaneously. Two such ovens are installed on each side of the furnace. Two ovens serve one drawing machine line. Each oven contains a pot chamber unit consisting of one pot with its pot chamber mounted on a carriage. This unit is supported by a trackage system designed to move the entire pot chamber unit in and out of the oven. The track system extends from the ovens through the area of the drawing machine positions. When a pot with its chamber and carriage is removed from its position at the glass furnace, another heated pot chamber unit can be put in its place without delay. A very minimum amount of time is required to replace the old unit with a new one which has already been pre-heated to the proper temperature. This is all accomplished by the system and its trackage which results in efficient handling of pots with the least amount of lost glass production.

Elaborate panelboards are installed to accommodate all items of instrumentation and automatic control equipment. Electronic potentiometers are used throughout for recording temperatures in the furnace proper, regenerators and flues. These instruments together with control and other instruments are mounted on their respective panelboards and located in enclosed instrument panel houses. A separate instrument panel house, located at the rear of the furnaces, is installed for each furnace.

Automatic control of furnace pressure, fuel flow, fuel-combustion air ratio and temperature of combustion air is maintained by using the latest type systems on both furnaces. Manual control is also provided in these systems in case of emergency. Recording and indicating instruments are used for constant checking of all control equipment. The combined use of the control equipment insures the operator of continual exact performance under any given set of conditions.

The water cooled flue reversing valves are also automatically operated. Reversal is done on a pre-determined time cycle. After a reversal has been made, a timer is used to set the desired delay of opening of the gas reversing valve beyond completion of reversal of the flue dampers and combustion air valve. Another timer is used to set the desired delay of opening of gas control valve after gas valve has been opened. Still another timer is used to set the delay of unlocking stack damper and combustion air inlet vane controls after gas control valve has started to open. This type of interlocking automatic system insures opening of gas valve, gas control valve, flue dampers and combustion air valve in proper sequence after each reversal. The same equipment is used to regulate conditions immediately prior to reversal. A semi-automatic push button reversal system is also installed if it is desired to operate without use of the fully automatic system. Transfer from the automatic to the push button system and back again to the automatic system can be done without interrupting firing of the furnace. A third or manual system is also installed for reversing in case the fully automatic or push button system is not used. All of these interlocked systems allows the operators to continue reversing and firing the furnace without interruptions or delays due to failure of certain equipment.

Both furnaces are supplied with mixed batch or mixed batch and cullet by means of a conventional batch can system with tracks and trolleys. Mixed batch and cullet normally are proportioned at the rear of each furnace and then spouted to the doghouse. A semi-manual lump

Bottom blocks of sheet furnace prior to heat-up.

Sheet furnace canals.

batch feed method is employed to push the batch piles into the furnace. These piles are positioned on the surface of the glass in a predetermined pattern across the width of the furnace.

Each furnace is equipped with the very latest design wind cooling system. These systems are installed to supply cooling air to all refractories in critical locations. In addition to cooling the melting end tank blocks, provisions are also made to cool other areas such as the port jambs, port connection arches at furnace breast walls and also the suspended curtains. The plate furnace wind cooling system has a total available output of 270,000 cubic feet of air per minute using six double width, double inlet blowers each directly connected to a 60 horsepower motor. The sheet furnace system has a total available output of 252,000 cubic feet of air per minute using six double width, double inlet blowers each directly connected to a 50 horsepower motor. The wind cooling systems were furnished and installed by the Kirk and Blum Manufacturing Company.

The water cooled flue reversing valves and stack dampers are constructed of cast iron. Steel enclosed hoods, designed to insure against leakage, are used with each of these units. This equipment with auxiliary drive mechanism was supplied by the Blaw-Knox Company.

The chimneys are constructed of red hollow tile and lined with fire brick. Actually, each chimney consists of two separate vertical shafts with an air space between each column. The outer column is the hollow tile material and the inner column is the lining. Chimneys are equipped with outside rung type ladders and lightning protection. Custodis Construction Company furnished and erected both chimneys.

Instrumentation and related equipment was supplied by several different manufacturers some of which are: Brown Instrument Division, Minneapolis Honeywell Company; Askania Regulator Company, Charles Engelhard, Inc.; Meriam Instrument Company and Bailey Meter Company.

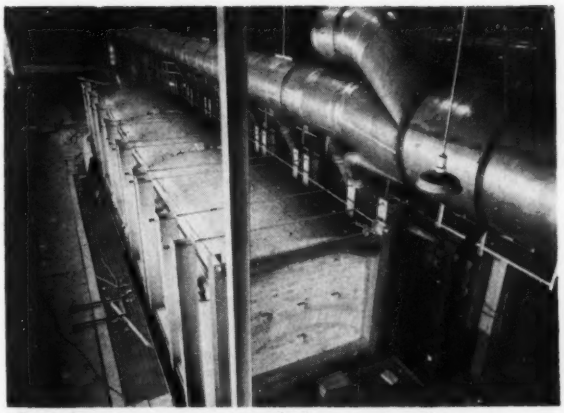
The large suspended curtains, that separate the melting from the refining end of each furnace, are supported on adjustable jacks. These curtains can be raised or lowered vertically with respect to the distance from the surface of the glass. Silica materials are used throughout on the sides and underneath surfaces of the curtains. The silica tiles are supported by special castings which in turn are attached to steel work in the inside of the curtain. This steel work is then supported by two large horizontal steel beams which rest on the adjustable jacks on either side of the furnace. Suspended curtains were furnished by the M. H. Detrick Company.

Refractories for construction of the furnaces were given very careful consideration. In general the following tabulation shows the various types of refractory materials used at different locations.

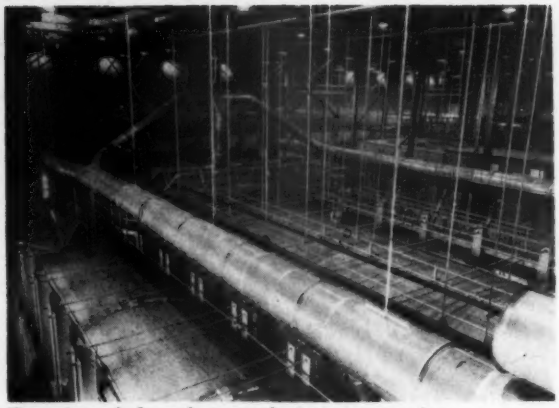
Location	*Type of Material*
Tank bottom, melting end	Heavy Flux
Tank bottom, refining end	Standard Flux
Tank side walls, lower course	Corhart—regular
Tank side walls, upper course	Corhart—Zac
Plate blocks, melting end	Corhart—Zac
Plate blocks, refining end	Silica
Breast walls, melting end	Monofrax-H
Breast walls, refining end	Silica
Crown skews and starter blocks, melting end	Monofrax-H
Furnace crowns	Silica
Port snouts, walls & crown	Monofrax-H and mullite*
Regenerator crowns and upper portion of regenerator walls	Mullite*
Checkers and lower regenerator walls	Super Duty Fire Brick
Flues	First Grade Fire Brick

Sheet furnace melting end.

Outside of sheet furnace canals during construction.



Sheet furnace regenerators during construction.



Top view of sheet furnace during construction.

Piers	Second Grade Fire Brick

* The word "mullite" pertains to various grades of the mullite type of refractories supplied by several different manufacturers.

Some of the refractory manufacturers that supplied materials for this project were: Aetna Fire Brick Company; Carborundum Company; Corhart Refractories Company; Davis Fire Brick Company; Findlay Clay Products Company; A. P. Green Fire Brick Company; Harbison-Walker Refractories Company; Louisville Fire Brick Company; Mullite Refractories Company, North American Refractories Company; Chas. Taylor Sons Company; and Walsh Refractories Company.

Toledo Engineering Company, Inc. were the prime contractors for erection of the furnaces and auxiliary equipment. Piping and electrical work, chimneys, wind cooling systems, etc. were sub-contracted by Toledo Engineering Company.

Layout of the furnaces in the building with respect to working conditions was very carefully planned. The two furnaces are located side by side with ample clearance for working areas between and around the regenerators and furnaces proper. Areas around the machine end of each furnace were also designed to give maximum flexibility with regard to work space for any repairs or services that may be required.

Regenerators for sheet furnace during construction.

GCMI SEMI-ANNUAL MEETING TO BE MAY 20-23 AT GREENBRIER

The annual membership meeting of the Glass Container Manufacturers Institute, Inc., an association of seventy manufacturers of glass containers, metal and molded closures, and supplier companies, will be held at The Greenbrier, White Sulphur Springs, West Virginia, from Tuesday, May 20th, 1958, through Friday, May 23rd, according to Victor L. Hall, GCMI's general manager.

General sessions will be held on Wednesday, Thursday, and Friday mornings. Speakers include Jacob Baker of The Econometric Institute, Inc.; W. E. Hoadley, Jr., of the Armstrong Cork Company; Edmund F. Ball, GCMI president; industry representatives and members of the GCMI staff.

J. C. Feagley of Armstrong Cork Company, is chairman of the program committee which includes C. G. Bensinger of Owens-Illinois Glass Company and J. S. Heuisler of Maryland Glass Company.

AWG AND BLUE RIDGE ANNOUNCE TERMS OF MERGER

On April 8, American Window Glass Company, Pittsburgh, Pa., made public the terms of merger with Blue Ridge Glass Corporation, Kingsport, Tennessee, to form a new company to be known as American-Saint Gobain Corporation. Officers of American urged shareholders to approve the proposal at their annual meeting April 22.

Otto G. Schwenk, president of American, said that proxy statements and copies of the plan of merger have been mailed to all shareholders.

ALLIED CHEMICAL SHORTENS NAME

One of America's large diversified chemical companies doing business since 1920 as Allied Chemical & Dye Corporation is about to become simply Allied Chemical Corporation.

In connection with the proxy statement sent to stockholders recently, Glen B. Miller, president, said:

"The board of directors believe that the proposed new name will more clearly reflect the broad nature of the company's position in the chemical industry and will not single out a particular division or field of activity.

"It is also believed that the shorter name will be better adapted to identify the company in its public and trade relations and in advertising its products."

The recommendation will require the affirmative vote of the holders of a majority of the outstanding common stock of the company and if approved will become effective by May 1.

According to Mr. Miller, the proposal "in no way implies lack of interest in our dye business." Referring to the history of Allied he said:

"When the company was formed in 1920, memories of the World War I dye famine, which had been relieved by National Aniline's all-out efforts, were fresh in peoples' minds and it was desirable at that time to give the new corporation the benefit of close association with National Aniline's achievement.

"Today there is no longer any reason for stressing any one line of products in the company's name, although synthetic organic chemicals, which include dyes, constitute roughly one-fifth of our production total."

Recent Translations of Russian Papers of Interest to the Glass Industry

Properties of Some Magnesia-Alumina Glasses

N. M. Pavlushkin, in *Steklo i Keramika* (Glass and Ceramics) *11*, No. 3, p. 10 (1954), describes some glasses intended to compete with resistant borosilicate glasses. The advantage of the experimental glasses lies in their not containing boron which is a relatively rare and expensive element.

The composition of the new glasses is shown in Table I.

All glasses were made in chamotte crucibles in 200 g. quantities. The furnace temperature was raised at the rate of 175°C/hour for 5 hours and then at 200°/hour for 3 hours, after which it was kept at 1500°C for 7 hours.

Five properties of the glasses were tested:—

1. Devitrification: The tendency of the glasses to crystallize on heating is summarized in Fig. 1. It is seen that one glass only (No. 26, containing boron) showed no divitrification tendency; all other glasses were more or less devitrified after being kept at 1000-1100°C.

2. Chemical endurance: Powdered glass was digested for an hour with boiling 80 per cent acetic acid. The loss in weight is shown in Table II, column B. The additions can be arranged in the descending order of their usefulness, as follows:

$$ZnO > TiO_2 > Na_2O > B_2O_3 > BaO > MnO$$

3. Thermal endurance: The least temperature difference (in °C) at which cracks occur is shown in Table II, column C.

4. Thermal expansion: Table II, column D lists the coefficient of thermal expansion (in 10^{-8} degree $^{-1}$C) between 18° and 120°. There is no addition which would lower this coefficient.

5. Softening temperature: Table II, column E shows the softening temperature (°C) of the glasses; this temperature is lowered by every one of the additions tested.

In summary, it has been shown that glasses containing no boron may be as suitable for chemical glassware as boron containing glasses.

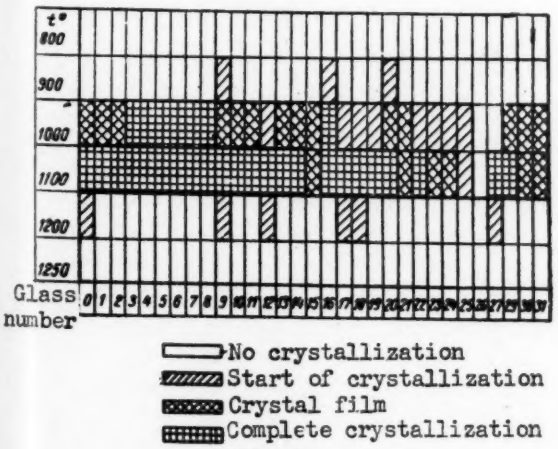


Fig. 1.

Table I

Glass number	SiO_2	Al_2O_3	CaO	MgO	Na_2O	Addition	
0	65.15	18.50	12.05	4.20			
1	65.15	16.50	12.05	4.20	2.0		
2	65.15	14.50	12.05	4.20	4.0		
3	65.15	13.50	12.05	4.20	5.0		
4	65.15	13.50	12.05	4.20	3.0	2.0	K_2O
5	65.15	12.50	12.05	4.20	6.0		
6	65.10	12.50	11.05	4.20	7.0		
7	65.10	12.50	11.05	4.20	5.0	2.0	K_2O
8	65.14	12.50	10.05	4.20	8.0		
9	65.13	14.50	12.05	4.20	2.0	2.0	BaO
10	65.13	12.50	10.04	4.20	4.0	4.0	BaO
11	65.14	12.50	8.02	4.20	5.0	5.0	BaO
12	65.15	16.50	12.05	4.20	1.0	1.0	TiO_2
13	65.15	14.50	12.05	4.20	2.0	2.0	TiO_2
14	65.15	12.50	12.05	4.20	3.0	3.0	TiO_2
15	65.14	12.50	10.04	4.20	4.0	4.0	TiO_2
16	65.14	12.50	8.05	4.20	5.0	5.0	TiO_2
17	65.13	16.50	12.00	4.20	1.0	1.0	ZnO
18	65.13	14.50	12.01	4.20	2.0	2.0	ZnO
19	65.13	12.50	12.01	4.20	3.0	3.0	ZnO
20	65.13	12.50	10.04	4.20	4.0	4.0	ZnO
21	65.14	12.50	8.02	4.20	5.0	5.0	ZnO
22	65.13	16.50	12.01	4.20	1.0	1.0	B_2O_3
23	65.13	14.50	12.01	4.20	2.0	2.0	B_2O_3
24	65.13	12.50	12.01	4.20	3.0	3.0	B_2O_3
25	65.13	12.50	10.04	4.20	4.0	4.0	B_2O_3
26	65.14	12.50	8.02	4.20	5.0	5.0	B_2O_3
27	65.13	16.50	12.01	4.20	1.0	1.0	MnO
28	65.13	14.50	12.01	4.20	2.0	2.0	MnO
29	65.13	12.50	12.01	4.20	3.0	3.0	MnO
30	65.13	12.50	10.04	4.20	4.0	4.0	MnO
31	65.14	12.50	8.02	4.20	5.0	5.0	MnO

Table II

	B	C	D	E
0	0.027	235	334	860
1	0.017	190	394	790
3	0.023	180	425	770
6	0.025	170	455	710
9	0.022	200	370	770
11	0.030	175	415	700
12	0.009	200	342	740
14	0.015	210	386	720
16	0.022	220	450	710
17	0.019	205	336	750
19	0.013	220	403	715
21	0.009	235	394	730
22	0.017	190	334	775
24	0.020	225	446	700
26	0.025	240	380	690
27	0.015	180	388	780
29	0.026	170	400	770
31	0.032	160	420	680

Effect of Magnesium Oxide On Devitrification

M. V. Okhotin and R. S. Levina published, in *Steklo i Keramika* (Glass and Ceramics) *11*, No. 11, p. 6 (1954), graphs of rate of crystallization versus temperature for 17 glasses containing 2.5 to 5.5 per cent MgO.

All glasses contained about 72.5 per cent SiO_2, 1-2 per cent Al_2O_3 and 15 per cent Na_2O, but the amount of CaO varied between 5.5 and 8.0 per cent in such a manner that the sum of MgO+CaO was 10.5 per cent or 11.5 per cent. Devitrification resulted in formation of devitrite, wollastonite or diopside.

The best combination of properties (slow crystallization and high viscosity) was shown by glasses containing 4 per cent MgO.

A New Laboratory Glass

K. I. Borisov gives in *Steklo i Keramika* (Glass and Ceramics) *11*, No. 11, p. 29 (1954) the composition of a new glass for laboratory ware:

SiO_2 68.1, R_2O_3 4.0, CaO 7.3, MgO 2.4, Na_2O 13.5, K_2O 1.4, ZrO_2 2.8, B_2O_3 0.5 per cent.

The glass has a satisfactory chemical and thermal endurance.

The Surface of Ground Glass

The two main inspection procedures for the surface of ground glass were compared by P. Ya. Bokin, *Steklo i Keramika* (Glass and Ceramics) 12, No. 1, p. 5 (1955).

One of these procedures uses stylus instruments and thus determines the surface roughness of the glass. However, a stylus cannot register a crack of any width if the crack is filled with glass debris. These fissures can be see in a microscope and their depth can be measured on a taper section of a ground surface.

The accompanying table shows that the average depth (d) of cracks is greater than the average height of hills (h) given by a stylus instrument and that the ratio d/h is a constant for each glass, whatever abrasive was used for the grinding. The first column of the table lists the name of the abrasive, in the second the particle size (in microns) is shown, columns 3 and 4 present h and d, respectively, both in microns, and column 5 is the ratio of d to h.

Abrasive	Particle size	h	d	d/h
Electrocorundum	300 — 200	38	140	3.7
	28 — 20	7	22.5	3.2
	20 — 14	5	20.4	4.1
Sand	42 — 28	5	20	4.1
	28 — 20	3	12	4.0
	20 — 14	3	11.7	3.9

Endurance of Glass in Boiling Water

This endurance was studied by V. I. Shelyubskii, *Steklo i Keramika* (Glass and Ceramics) 12, No. 1, p. 8 (1955). He kept glass in boiling water for a definite time, dried it, made a silica replica of the glass surface, and examined the replica in an electron microscope at a magnification of approximately 10,000.

The main result of the study was that a visible attack on the surface occurred within 5 minutes when the glass was polished mechanically, while about 20 minutes boiling were needed to cause visible corrosion of a fire-polished glass. If a microscratch was made on a glass before the experiment, corrosion greatly enlarged the scratch. The glass used had the code number ZS-5; no composition is given.

Adhesion of Molten Glass to Molds

To study the basic phenomenon of this adhesion, the following experiments were performed by V. T. Marinina, *Steklo i Keramika* (Glass and Ceramics) 12, No. 1, p. 9 (1955).

A drop of molten glass weighing 0.39 to 0.40 g. was allowed to fall from a height h onto a plate tilted at an angle of 45 degrees to the horizontal. The temperatures of the molten glass and of the plate were varied independently of each other and that pair of temperatures was noted at which the drop remained attached to the plate immediately after contact.

Some results are listed in the accompanying table. Its first column shows the temperature of the molten glass (in °C); the 2nd, 4th, 6th, and 8th columns show the temperatures of the plates at which adhesion occurred when the drops fell from a height $h = 11$ cm.; and the 3rd, 5th, 7th, and 9th columns give the corresponding information for $h = 6$ cm. The material of the plate is marked in the table.

	Cast iron No. 6		Steel EYaIT		Copper		Ceramics	
Temp., °C	11 cm.	6 cm.	11 cm.	6 cm.	11 cm.	6 cm.	11 cm.	6 cm.
1010	700	680	730	700	720	680	740	700
1050	700	680	710	670	720	660	730	700
1100	640	640	600	590	700	660	710	690

The conclusions from the data of the table and other data not reproduced here are:

the temperature of the plate at which adhesion starts to take place (i.e., the adhesion temperature) is higher the greater the height from which the drops fall, that is the colder the drop when it touches the plate;

the adhesion temperature is higher also when the temperature of the molten glass is lower, that is again when the drop is colder in the moment of contact; and

the adhesion temperature is higher when the metal of the plate is less rapidly oxidized by hot air.

Devitrification of Window Glass

This was studied by I. I. Kitaigorodskii, T. N. Keshishyan and B. G. Varshal, *Steklo i Keramika* (Glass and Ceramics) 12, No. 2, p. 4 (1955).

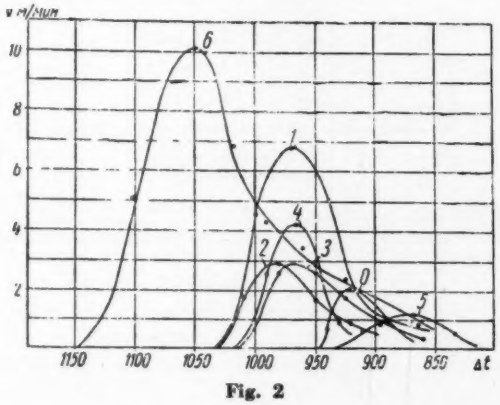


Fig. 2

Samples of window glass manufactured by seven Russian plants were heated in a "crystallizing oven" for 120 minutes and the length of the crystals formed during this time was measured in a microscope. If the average length was L, then v plotted in the figure is $L/120$ microns/minute. The seven curves in Fig. 2 refer to glasses whose composition is shown in the table.

Glass Number	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O	SO_3
0	72.00	1.50	0.00	8.50	3.00	15.00	0.00
1	71.74	1.99	0.18	9.32	0.17	15.71	0.84
2	72.7	1.28	0.20	6.97	3.89	14.72	0.29
3	72.11	1.22	0.29	5.40	4.05	16.70	0.27
4	72.23	0.86	0.10	8.08	2.90	15.11	0.28
5	72.00	1.28	0.14	7.15	3.41	15.63	0.47
6	72.00	0.79	0.12	7.00	4.39	15.26	0.42

The abscissa of the graph is the temperature of the crystallizing oven. It is seen that the rate of crystallization (that is, v) is particularly low and the region of temperatures in which devitrification occurs is particularly narrow for the glasses No. 0, 2 and 5. As is clear from the table, the ratio of alumina to magnesia for these glasses varies only between 0.33 and 0.50.

Loss of Fluorine in the Manufacture of Milk Glass

M. A. Tsaritsyn reports on it in *Steklo i Keramika* (Glass and Ceramics) 12, No. 2, p. 15 (1955).

When the batch contained, for instance, 8.9 per cent fluorine, the glass made in a furnace contained only 4.5—5.9 per cent F. Another glass was made in a pot at 1450—1470°C and then worked at 1150—1250°C, and its fluorine content was determined at different stages of the manufacture; this content decreased as an almost linear function of time; the batch contained 9.3 per cent F. and the glass goods only 5.0 per cent F.

From a comparison of the complete analyses of batch and formed glass it is possible to determine in what form fluorine was lost. If, for instance, the total amount of sodium in the glass is practically equal to that in the batch, it is clear that the fluorine did not escape as sodium fluoride vapor. The results indicate that SiF_4 is the main fluorine compound lost during the process, while some loss of HF also occurs.

Price Structure of Window and Mirror Glass

According to the scheme presented in *Steklo i Keramika* (Glass and Ceramics) 12, No. 3, p. 25 (1955), the list price of window glass is calculated according to the equation

$$P = Abcd.$$

In it, P is the price of unit area of glass, A is that of the thinnest glass of the first quality in small sizes, b is the quality coefficient, c is the thickness coefficient, and d is the area coefficient.

The quality coefficients are—first quality 1.00, second quality 0.80, and third quality 0.55.

The thickness coefficients for the five standard thicknesses of window glass are:

Thickness in mm.	Coefficient
2.0 — 2.3	1.00
2.8 — 3.2	1.36
3.6 — 4.3	1.82
4.7 — 5.3	2.27
5.6 — 6.4	2.73

The area coefficients are:

Area in sq. meters		Coefficient
0.0625 — 0.145	(1)	1.00
0.146 — 0.400	(2)	1.91
0.401 — 1.000	(2)	2.29
1.001 — 1.800	(3)	2.75
1.801 — 2.640	(4)	3.30
2.641 — 3.520	(5)	3.96

(1) available only in the thickness range 2.0—2.3 mm.
(2) available in all thicknesses.
(3) available in all thicknesses except the range 2.0—2.3 mm.
(4) available in the thicknesses of 3.6 mm. and above
(5) available in the thicknesses of 4.7 mm. and above.

Thus, for instance, the price of a sheet of 0.3 meter^2, 3.0 mm. thick, second quality, is 0.80x1.36x1.91=2.08 times that of the standard glass (that is, A is the equation). The price of the most expensive glass is 1.00x2.73x3.96 A = 10.81 A.

An analogous equation exists for the price of polished glass. There are five values of the quality coefficient, namely 1.00 for best mirror, 0.75 for second quality mirror, 0.65 for furniture glass, 0.60 for transport glass and 0.50 for construction glass. There are three thickness coefficients, namely 1.00 for 4 to 5 mm., 1.05 for 5.1 to 7.0 mm. and 1.20 for 7.1 to 9.0 mm. The six area coefficients are:

Area in sq. meters	Coefficient
0.075 — 0.20	1.00
0.21 — 0.50	1.67
0.51 — 0.80	2.00
0.81 — 1.00	2.40
1.01 — 1.50	2.88
1.51 — 2.00	3.46
2.01 — 3.00	4.15

A Glass Cutter for Cutting Off Edges

When the edges of a glass sheet are continuously cut off, glass cracks sometimes develop. Yu. I. Bogdanov, in *Steklo i Keramika* (Glass and Ceramics) *12*, No. 4, p. 31 (1955), traces these cracks to vibrations of the cutter which, from time to time, hits the glass sheet and causes fragmentation.

To avoid these vibrations, Bogdanov made an instru-

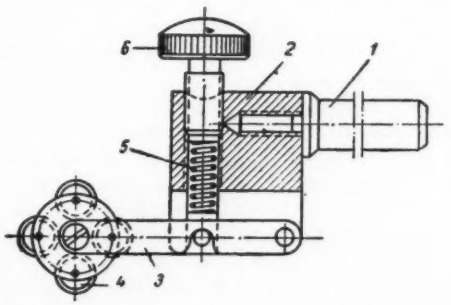


Fig. 3

ment illustrated in Fig. 4. As the drawing shows, the actual cutting discs (4) are connected to the rigid supporting rod (1) by means of a spring (5) which damps the vibrations. Item 2 is the housing for the spring, item 6 is a screw adjusting the tension of the spring, and item 3 is the lever to which the cutting discs are attached.

Supersonic Boring and Grinding

Boring of glass with supersonic vibrations is suggested by L. B. Pirozhnikov and I. S. Wainshtok in *Steklo i Keramika* (Glass and Ceramics) 12, No. 6, p. 7 (1955).

The principle of the method is outlined in Fig. 4. The puncher 2 is surrounded with an electromagnet symbolized as a coil in the sketch. When the supersonic generator 1 energizes the magnet 15,000 to 30,000 times every second, the puncher hits glass plate 3 with the same frequency. Thus, contrary to the ordinary drilling, the tool does not rotate but rather strikes the glass. Because no rotation is involved, the puncher may have any shape and thus can produce holes of any outline, such as stars, squares, and so on.

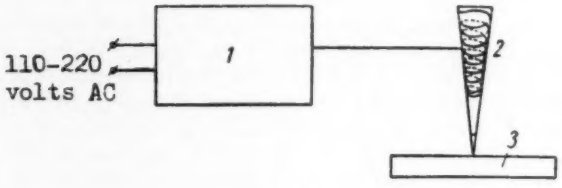


Fig. 4

The puncher does not itself cut the glass. The glass surface is covered with an abrasive paste (boron carbide is recommended), and the puncher pushes the abrasive grains into the glass. The average pressure on the puncher is small; otherwise the puncher would cease to vibrate in resonance with the supersonic generator.

When the plate is 0.1 to 8 mm. thick, the final hole is between 0.1 and 10 mm. wide, and the generator's power is 500 watts; the boring takes from 15 to 120 seconds. The precision of the shape of the final hole depends on the fineness of the abrasive powder; with a fine boron carbide the deviations from the prescribed shape are 0.015 mm. or smaller.

Grinding of glass with a similar instrument was tested by M. A. Bezborodov, A. A. Gezburg and N. P. Krasnikov (same issue, p. 11).

Instead of a narrow puncher, a wide steel plate parallel to the glass plate was used, and the glass was slowly moved in its own plane. Thus, at every vibration, abrasive grains were pressed against the glass and scratched it because the glass plate moved all the time.

The generator had a power of 200 watts and a frequency between 26,000 and 28,000 sec^{-1}. The amplitude of the vibrations of the steel plate was 0.005 to 0.02 mm. In about 30 seconds the thickness of the removed glass reached 0.01 to 0.05 mm., and the remaining indentations were 1 to 2.8 microns deep.

Boron carbide proved to be the best abrasive, electrocorundum the next best, and alumina the least satisfactory.

Devitrification and Chemical Composition

L. I. Demkina with four collaborators published an attempt on predicting the rate of devitrification from the chemical composition of glass in *Steklo i Keramika* (Glass and Ceramics) 12, No. 8, p. 6 (1955).

Twenty two different glasses were prepared and heated to 400—950°C, after which the thickness of the crystallized layer was measured; if this was immeasurably small, the glass was put down as of class 0; and classes 1, 2, and 3 corresponded to ever increasing rates of crystallization.

The glasses contained from 72.10 to 74.73 mol. per cent SiO_2, 0 to 3.95 mol. per cent B_2O_3, 0.13 mol. per cent As_2O_3, 0 or 3.64 mol. per cent BaO, 3.51 to 5.55 mol. per cent ZnO, 0 to 8.32 mol. per cent CaO and 11.10 to 16.02 mol. per cent alkali.

If a group of three or four glasses was selected, in which the ratio of Na_2O to K_2O varied while the composition otherwise remained nearly constant, it was every time observed that the rate of crystallization was smaller the nearer the ratio of Na_2O to K_2O was to that given by the equation "ratio $= \frac{0.23}{x} - 1.3$", x being the mole percentage of K_2O. It is known that, in general, the rate of crystallization is small if the composition of the glass is near that of a boundary between two phases. Demkina believes that the above equation corresponds to the boundary between the stability regions of quartz and tridymite. Thus the ease of devitrification can be predicted from the distance of the glass composition from a phase region boundary.

Surface Temperature of Glass During Polishing

V. M. Obukhov and A. S. Makhnovetskii advocate, in *Steklo i Keramika* (Glass and Ceramics) 12, No. 9, p. 28 (1955), a continuous measurement of the surface temperature of glass as a test for the polishing procedure.

The instrument used for this measurement is shown in Fig. 5. The glass plate marked 00 moves to the left

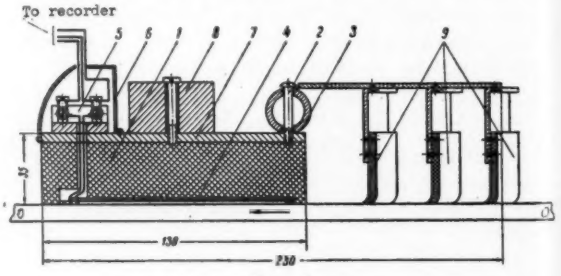


Fig. 5

as indicated by an arrow. A wire (4) is kept 1.0—1.5 mm. above the glass surface, and the electric resistance of the wire is continually recorded on a scale calibrated for direct temperature indication. The connection between the recorder wires and resistance wire 4 occurs on the little terminal board 5 housed in an air-tight box 6. The constant clearance between the resistance wire and the glass surface is maintained by the rubber block 1 whose bottom contains a groove for the wire. The

(*Continued on page* 296)

Inventions and Inventors

Annealing and Tempering

Glass Bending Lehrs. Patent No. 2,794,300. Filed January 31, 1956. Issued June 4, 1957. 6 sheets of drawings; none reproduced. Assigned to Pittsburgh Plate Glass Company by James S. Golightly.

The present invention relates broadly to glass bending lehrs. More particularly, it relates to improvements in glass bending lehrs which bend flat glass sheets into shapes of a complex nature having regions of relatively gentle curvature and other regions of relatively severe curvature.

Glass sheets are conventionally bent by mounting them while flat on suitable molds and introducing the glass laden molds into a tunnel-like lehr having zones of progressively increasing heat. When the glass reaches a zone where the temperatures are sufficiently high, the sheets soften and settle onto the surface of the supporting mold. When the mold surfaces include quite sharply curved areas, it has been found advantageous to create local zones of concentrated heat in the general furnace heating zones to cause more rapid softening of those portions of the glass sheet which are to settle into registry with the sharply curved regions of the mold.

The improvement in apparatus for bending glass sheets into complex bends is accomplished by having a central area of relatively gentle curvature flanked by regions of relatively sharp curvature which utilize electrical heating elements in the bending section of the lehr. There are means for controlling the vertical and horizontal positions of these elements, independently of each other, to provide spaced zones of intense radiation aligned with the regions of the glass sheets to be bent most severely as the latter are conveyed through the bending sections.

There were 10 claims and 11 references cited in this patent.

Feeding and Forming

Safety Stop Mechanism for Glassware Making Machine. Patent No. 2,790,425. Filed December 31, 1953. Issued April 30, 1957. Two sheets of drawings; none reproduced. Assigned to Lynch Corporation, by Armand D. Norris.

This invention relates to an improved glassware making machine having arresting mechanism operable from any one of many locations and effective when actuated to stop the machine immediately and hold it in the stopped position until reset.

The operation of the machine can be arrested by actuating any one of a plurality of safety valves located at appropriate points about the machine. Each valve is connected to the air source used in the machine and to a common outlet pipe so that actuation of any one of the valves applies pressure from the source to the pipe. The pressure thus available at the common outlet pipe actuates a control valve which performs two functions. First, it interrupts the supply of operating fluid to the piston which normally actuates the reciprocating member. Then, it applies fluid to a brake actuating mechanism to engage the same and thus this mechanism opposes further motions of the machine. Thus, operating power is simultaneously interrupted and braking action is applied, bringing the machine to a stop even though part way through a motion of the reciprocating member. In addition, brake force is applied to hold the reciprocating member in whatever position it may stop.

The invention, therefore, supplies a safety means to arrest operation of a glassware making machine that is flexible and can be applied to provide safety devices located at will about the machine. It is reliable, utilizes the machine operating air to arrest operation, and is simple and easily constructed and maintained.

There were 6 claims and 11 references cited in this patent.

Furnaces

Apparatus for Tempering Glass. Patent No. 2,790,270. Filed July 12, 1954. Issued April 30, 1957. Eight sheets of drawings; none reproduced. Assigned to Pittsburgh Plate Glass Company by James M. Freiberg.

The present invention relates to apparatus for tempering glass, and more specifically, to apparatus which assures an even temper being imposed upon a curved sheet of glass having different radii of curvature along an axis thereof.

These objects have been accomplished by modifying existing tempering apparatus to convert the longitudinal reciprocating component of the flat orbital movement of a structural element thereof into a compound motion including a reciprocation perpendicular to the plane of orbital movement. This change is accomplished by moving upper and lower nozzle members horizontally in a fixed orbit with a movable frame and pivoting curved wing boxes containing additional air nozzles at each extremity of the nozzle members to allow the nozzles contained in these wing boxes to be pivoted vertically in concert with the horizontal orbital movement of the nozzle members. This pivoting allows the wing box nozzles to remain a fixed spaced distance from the curved edges of the glass sheet being tempered.

In a preferred embodiment of the invention, a frame structure containing opposing nozzles is moved orbitally in a horizontal plane. A fixed housing is provided with a series of ball transfers against which specially shaped wear plates provided on the pivotable wing boxes abut. Thus, the horizontal orbital motion typical of the prior art tempering apparatus nozzles has been transformed into a combination of movements. This combination includes a substantially unchanged motion of the central nozzles opposite the central portion of the glass merging into a combination of horizontal and vertical movements of the wing box nozzles opposite each extremity of the glass to enable each latter nozzle to follow a contour substantially parallel to that of a small portion of a glass extremity.

There were 13 claims and the following references cited: 2,166,427, Drake, July 18, 1939; and 2,608,029, Glynn, Aug. 26, 1952.

Glass Compositions

Optical Glass. Patent No. 2,777,774. Filed January 21, 1953. Issued January 15, 1957. No sheets of drawings. Assigned to Ernst Leitz, G. m. b. H., by Gustav Weissenberg et al.

The invention relates to optical glass and more particularly to a glass of unusually low dispersion. These glasses are colorless and substantially not attacked by the atmosphere. Moreover they can be pressed at the temperatures customary for this purpose. A further advantage of these glasses is that they may easily be made free from striae.

It has long been known that phosphates of the alkaline earth metals alone, either singly or as a group, are indeed glass forming and easily yield crown glasses. These crown glasses are tied to various disadvantages. First, the index of refraction of the single metaphosphates is generally, relatively very low. Second, the metaphosphates are very viscous so that it is very difficult to form glass free from striae. It was therefore proposed to melt metaphosphates with a slight excess of oxides of the same elements or with metasilicates or metaborates of the respective elements. Melting of the individual metaphosphates to crown glasses has been avoided for many years.

The new crown glasses of the invention are obtained by the common melting of a mixture of at least one metaphosphate of the elements of the group consisting of magnesium, calcium, strontium, barium with at least one oxide of an element of the group consisting of boron, calcium, strontium and barium. In a further development carbonates may also be combined with the metaphosphates and indeed from the group of elements consisting of lithium, sodium, strontium, and barium.

Further, the metaphosphates may be combined with one or several orthophosphates of the same group while at the same time oxides or carbonates may be incorporated as additives. The oxides or the phosphate of lanthanum or indium may be added to raise the index of refraction of the mixed melt.

There were 2 claims and the following references cited in this patent: 2,278,501, Tillyer et al., Apr. 7, 1942; and 2,294,844, Gelstharp, Sept. 1, 1942.

Optical Glass. Patent No. 2,787,554. Filed November 24, 1954. Issued April 2, 1957. Assigned to Eastman Kodak Company by Paul F. De Paolis.

A glass resulting from fusion of a glass batch consisted essentially of the following percentages by weight:

	Per cent
Lanthanum oxide	28
Tantalum oxide	20
Barium tungstate	2
Barium oxide	3
Thorium oxide	25.5
Boric oxide	21.5

There was one claim in this patent.

Glass Wool and Fiber

Producing Metal-Coated Glass Fibers. Patent No. 2,782,563. Filed November 23, 1953. Issued Feb. 26, 1957. One sheet of drawings; none reproduced. Assigned to Owens-Corning Fiberglas Corp. by Robert G. Russell.

This invention relates to glass fibers, particularly a method and means for producing metal coated glass fibers to increase their wear resistance and usable strength. More specifically, it relates to coating glass fibers with metals and metal alloys provided in sheet form.

The principles of the invention entail coating glass fibers with metal by feeding metal such as aluminum, lead or tin in sheet or foil form into contact with the heated fibers as they are being formed. This concept resolves itself into two phases. In the first the heat of formation of the fibers is used to melt thin sheets or foils of metal being supplied thereto; according to the second, the metal supplied to the filaments is preheated and regulated in temperature to aid the heat of fiber formation to melt the metal and thereby also reduce the possibility of effects from undesirable chilling of the glass by the metal being fed.

A feature of the invention is the rapidity with which the desired temperature can be imparted to the metal, thus making the method and means flexibly adaptable to providing the physical properties controllable by selection of particular temperature relations between the metal and glass fibers.

There were 11 claims and the following references cited in this patent: 2,323,684, Simison, July 6, 1943; 2,373,078, Kleist, Apr. 3, 1945; 2,616,165, Brennan, Nov. 4, 1952; and 849,842, France, Aug. 28, 1939.

Apparatus For Making Fiber Articles. Patent No. 2,789,199. Filed November 15, 1951. Issued April 16, 1957. One sheet of drawings; none reproduced. J. A. Bjorksten; no assignee.

In accordance with this invention, a film is moved continuously through a wire grid and is cut thereby into fine strands. In the particular application envisaged, the wires are mounted to bars which are kept in alignment with each other by means of rigid edge bars. The lower bar is rigidly mounted to a wheel by means of which it can be swung in the horizontal plane, so that the intersectional area of the fibers with the film can be varied as desired. In other words, the angle at which the plane, determined by the metal wires, intersects the direction or flow of the film moved through it, is determined by the wheel. The upper bar is urged up by spring means which maintains tension in the metal wires. Furthermore, the said wire is under the influence of an oscillating means, which causes a vibraton or oscillation in the wires of between 1,000,000 to 5 oscillations per second, the preferable range being between 125,000 and 25 oscillations per second, thereby affecting and facilitating the cutting action upon the film. This oscillating means may be any of the electrical oscillators or mechanical vibrators which are well known to the art. The cutting wires may be maintained at a temperature of 20 degrees C. above the softening temperature, which is more than 50 degrees C. above the softening temperature of the film.

There were 2 claims and the following references cited in this patent: 771, 518, Wilson, Oct. 4, 1904; 1,169,262, Huff, Jan. 25, 1916; 1,445,992, Cameron, Feb. 20, 1923; 2,004,580, Meyer, June 11, 1935; 2,035,138, Maxfield, Mar. 24, 1936; 2,430,496, Dodge, Nov. 11, 1947; 2,459,803, Francis, Jan. 25, 1949; and 2,483,405, Francis, Oct. 4, 1949. Also, Thomas et al "Soldering Aluminum Alloys", *Electronics* June 1948, 90-92.

Fiber Forming Apparatus. Patent No. 2,783,590. Filed March 4, 1953. Issued March 5, 1957. One sheet of drawings; none reproduced. Assigned to Owens-Corning Fiberglas Corporation by Charles J. Stalego.

This invention relates to fiber forming apparatus and more particularly to apparatus for the formation of relatively large sized continuous filaments from molten material by drawing the filaments from a mass of the molten material.

The attenuation of the individual glass filament depends not only upon the speed at which it is linearly drawn but upon its losing sufficient heat so as to solidify gradually and thus be stretched and attenuated a controlled amount between the time when the mass of glass is at its molten temperature within the tank and when the glass reaches a sufficiently lower temperature at the point of final reduction of diameter and formation of the individual filament.

A structure for forming a single glass filament is shown. It comprises a hollow tubular metal body extending down from a molten glass container and communicating therewith. The tubular body has an open lower end and a plurality of heat absorbing radial vanes attached to its inner wall and extending axially at least through part of the body and beyond the lower end thereof for absorbing heat from the glass passing through it and for conducting the heat to the wall of the body.

There was one claim and the following references cited in this patent: 2,462,805, Danner, Feb. 22, 1949; 2,596,042, Park, May 6, 1952; 381,582, Great Britain, Sept. 29, 1932; and 543,172, Great Britain, Feb. 12, 1942.

Sheet and Plate Glass

Apparatus for Grinding Glass. Patent No. 2,776,527. Filed October 5, 1954. Issued January 8, 1957. One sheet of drawings; none reproduced. Assigned to Pittsburgh Plate Glass Company by Eugene Hoyet and Ethmer J. Hazen.

The patent relates to apparatus for grinding glass, and in particular concerns certain structural refinements, particularly relating to the method of attaching a grinder runner to a steel deck of a glass grinding apparatus.

According to the present invention, replacement runners are attached to a steel deck by utilizing a cement mix of Portland cement and sand. Such a method of attachment avoids the necessity of grinding the runners in sand to eliminate thickness variations between runner castings, because the individual castings which comprise the grinder runner are adhered to cement and allowed to set on a slab with the grinding surface of the runners abutting a flat object until the runner castings set in the cement. Should it be required to remove an individual casting, a pneumatic jack hammer can break the bond between the casting and the cement without affecting the bond between the additional castings and the cement. Thus, each grinder runner replacement may be effected in a relatively short time compared to that required to remove and replace over a thousand bolts or screws. Also, the thickness of the bed of cement required to support the grinder runner onto the steel deck is much less than that previously required for the wooden deck and the strength of the cement bond is greater than that obtained by screwing the runners onto the deck. Thus, thicker grinder runners which require less frequent replacement may be used with cement bonding than with attachment by screws to a wooden deck.

Another advantage obtained by utilizing cement to bond the grinder runners to the steel deck is that failure of the bond between the runner and the cement is easily observed, whereas grinder runners bolted or screwed directly to steel or wooden decks may wobble considerably before the failure of the attachment is noted.

There were nine claims and the following references cited in this patent: 1,898,012, Hitchcock, Feb. 21, 1933; 2,241,433, Walker, May 13, 1941; 2,353,864, Wooddell, July 18, 1944.

Apparatus for Surfacing Articles. Patent No. 2,780,035. Filed April 9, 1954. Issued February 5, 1957. One page of drawings; none reproduced. Assigned to Pittsburgh Plate Glass Company by Carl Wintgens.

This invention relates to an apparatus for polishing, buffing or abrading surfaces of material. It has particular relationship to an apparatus suitable for surfacing large, heavy materials such as large sheets of plate glass.

In the manufacture of plate glass there are frequently scratches or defective areas on the surface of the glass which are of such a nature that they are insufficient to cause rejection of the sheet of glass but nevertheless are objectionable from an optical standpoint. These areas are subjected to buffing wheels known as "scratch wheels" to smooth out the defects and render the glass commercially acceptable. When large sheets of plate glass are to be locally buffed by such wheels, two or more men are required to hold the glass adjacent to the buffing surface and otherwise manipulate the glass.

In accordance with the present invention an apparatus for surfacing these large sheets of glass has been provided which enables one man to handle and surface the glass easily. This apparatus comprises a suitable surfacing wheel or buffing wheel disposed in combination with a table having castors mounted on its surface for supporting the glass. The apparatus also embodies a simple mechanism for replenishing a buffing solution on the surfacing wheel by the operator while he is surfacing the sheet of glass.

There were five claims and 14 references cited in this patent.

Improvements in Apparatus for the Continuous Drawing of Glass Sheets. Patent No. 2,780,032. Filed February 5, 1953. Issued February 5, 1957. Three sheets of drawings; none reproduced. Assigned to Compagnies Reunies des Glaces & Verres Speciaux due Nord de la France by Bernard Long.

The present invention relates to apparatus for the continuous drawing of glass into sheet form by means of which the drawing speed is increased.

The object of the present invention is to provide improvements in means for the continuous mechanical drawing of glass in sheet form, this means enabling the maximum drawing speed to be greatly increased for a given thickness and consists essentially of apparatus for creating at the surface of the foot of the sheet a surface layer or skin of high viscosity whereas the glass inside the foot of the sheet possesses a relatively low viscosity.

Two skins are formed at the foot of the glass having a high viscosity and between these two skins is the glass having a relatively low viscosity.

The formation of a skin of high viscosity at the surface of the foot of the sheet enables a sort of sheath to be formed by the two adjacent skins, said sheath being almost rigid and being able to withstand the mechanical drawing forces and being filled with glass which is much less viscous.

The cooling arrangements consist of two kinds of members, namely:

(a) blower members which project a gaseous fluid on to the glass at an angle and at a suitable speed and temperature, and

(b) suction members which take up the gaseous fluid and evacuate it from the drawing chamber as soon as it has swept over the surface of the glass, these members being necessary in order to prevent the occurrence of eddying of the gaseous fluid in the drawing chamber, whose effect might be harmful, particularly by causing irregular cooling of the faces of the sheet.

These two types of members may be arranged in a single apparatus or they may be arranged a short distance from each other. In general, the blower members and the suction members are arranged with their axes parallel to the sheet. There were 2 claims and 13 references cited in this patent.

Mirror Having a Dichroic Layer. Patent No. 2,776,598. Filed April 13, 1951. Issued January 8, 1956. One sheet of drawings; none reproduced. Assigned to Charles P. Dreyer, Gertrude C. Dreyer, and Lawrence R. Lytle by John F. Dreyer.

This invention relates to mirrors in general and particularly to devices which reflect polarized light.

The mirror comprises a metallic reflecting surface which has a protective coating such as a lacquer, tough paper or plastic film, etc., on its rear surface. In direct and full optical contact with the smooth reflecting front surface of the metallic layer is a polarizing layer of uniformly oriented dichroic material in the form of a film having a minute thickness, in this case less than a thousandth of an inch. This film is composed in the present instance of a material which is capable of passing through the nematic state, and, as exemplified, is a "nematic" dye, i. e. Resorcin Brown, Color Index No. 234. In front of the polarizing film is a suitable transparent support, e. g. glass or quartz, polystyrene or methyl methacrylate resin or other transparent support with optically accurate surfaces, one of which is in full optical contact with said polarizing film.

It is a great advantage of these mirrors that a wide range of colors is available among the dyes of the type set forth. For example, for automobile mirrors a dye reflecting mostly in the yellow green range is desirable; whereas for cosmetic mirrors a dye giving a peach color is desirable. There were 5 claims and 11 references cited in this patent.

Tube and Cane Machines

Hypodermic Syringe. Fig. 1. Patent No. 2,792,833. Filed May 20, 1952. Issued May 21, 1957. One sheet of drawings. Assigned to Becton Dickinson and Company, by Julius V. Magash and Charles Messineo.

This invention relates to a structurally and functionally improved hypodermic syringe, the present application being a continuation in part of prior application for United States Letters Patent, Serial No. 221,220, filed April 16, 1951, now Patent No. 2,736,992, entitled "Hypodermic Syringe and Method of Making the Same."

By means of the present invention a syringe assembly is produced which will be of the all-glass type and which will have a long effective life despite the fact that it may be subjected to repeated cleaning operations involving the use of detergents, repeated sterilizations and other uses which ordinarily decrease or destroy the usefulness of such an assembly.

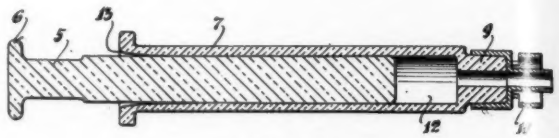


Fig. 1

Referring to Fig. 1, the numeral 5 indicates the plunger which in the usual manner may be provided with a rear or actuating portion 6 in the form of a thumb contacting surface. The body of this plunger extends into the bore of a barrel 7. The latter, in accordance with conventional design is conveniently provided, adjacent to its open rear end, with an outstanding flange portion 8 of suitable configuration. Its forward end preferably terminates in a tip 9 upon which any suitable fitting 10 may be secured so as to mount a needle. The face of the barrel receives indicia 11 (not shown). The latter includes sub-divisions indicative, for example, of cubic centimeters and minums. These sub-divisions serve to register with the forward end of the plunger so that a physician will be aware of the dosage which is being injected.

Both the plunger and the barrel are formed of a suitable glass composition and the barrel is constructed in accordance with the teachings of the afore-identified application. The bore 12 of the barrel is unground. Therefore, to all practical intents, the body of the barrel may be clear so that the interior of the bore is readily visible if the barrel be formed of a composition such that a transparent unit results. The only optical obstruction will be the possibility of air bubbles which, due to the shrinking of the barrel and the fact that it is not ground, will not provide objectionable "air lines." As shown especially in Fig. 1, the barrel bore adjacent to the rear or open end is preferably flared to a slight extent as indicated at 13. Such flaring will be located wholly beyond the part of the bore which receives the medicament; the sealing fit between the plunger and bore occurring at points forward of this flaring.

It has been found that by employing a barrel having a bore which is smooth and presents the characteristics of unground glass and using that barrel in conjunction with a ground plunger an extremely desirable assembly is furnished.

There were 5 claims and 10 references cited in this patent.

(*Continued on page* 298)

Determination and Use of the Sag Point as a Reference Point in the Heating of Glasses

• ONE OF THE MORE widely accepted definitions of glass is that it is a material that has cooled from the liquid state without undergoing a change in phase. Though glass may be regarded either as a supercooled liquid or an amorphous solid, the latter designation is more appropriate to stress the fact that ostensibly glass behaves like a solid, i. e., it retains its shape and reacts elastically to shear and tensile stresses. The process of transition from liquid to glass on cooling or from glass to liquid on heating is a continuous one. There is no sharply defined temperature, corresponding to the melting point of a crystal, at which it can be said that glass melts. Glass technologists have found it necessary, therefore, as a practical matter, to define certain reference points in the heating or cooling process so that reasonable comparisons can be made between glasses of different compositions, similar to the comparison of crystals by their melting points. Because the reference points for glass are not sharply defined, their selection is, in a sense, arbitrary. Their choice, however, is governed by established procedures in the annealing, forming, or other stages in the production process.

Glasses of different compositions have different temperature-viscosity relationships. Hence, glasses whose reference points might correspond in one temperature region, such as the annealing range, will, in all probability, not have corresponding points in another region such as the forming range. Considerations of this nature show why more than one reference point is necessary.

Littleton and Roberts and Littleton made the original contributions to the establishment of reference points by defining successively the annealing and softening points. Significant refinements and additions have been made by Lillie. The American Society for Testing Materials defines several such points now in use. These points are usually defined in terms of a specific phenomenon associated with a set of experimental operations, and also in terms of the viscosity of the glass at the temperature of this phenomenon. For instance, the deformation point is defined as "the temperature observed during the measurement of expansivity by the interferometer method at which viscous flow exactly counteracts thermal expansion. The deformation point generally corresponds to a viscosity in the range from 10^{11} to 10^{12} poises." The point defined by an operational procedure is preferable, because the experimental procedure can usually be reproduced more accurately than the viscosity can either be calculated from the experimental conditions, or measured at the same temperature by some independent method. Furthermore, the viscosity frequently is not the only determining parameter. In the case of the softening point, for instance, the density of the glass must also be considered. The kinematic viscosity, then, would be the relevant factor. The situation is further complicated by the fact that at a lower temperature a considerable time may be required before the glass comes to the equilibrium viscosity for that temperature. This fact has led Lillie to regard the strain point, which occurs in such a low temperature region, to be of limited significance. It may also be mentioned, in this connection, that Adams, in his well-known paper on the annealing of glass, doubted whether the viscosity, which is designated as a megoscopic property, was really related to the release of stress, which involves only microscopic processes.

It became necessary to devise a reference point that would serve as a reliable guide for annealing a large number of glasses of widely varying compositions. In order to be serviceable, it was also necessary for the determination of this point to be rapid and reproducible. Spinner, Cleek and Hamilton describe such a procedure in the September 1957 issue of the *Journal of Research of the National Bureau of Standards.*

The technique for determining the sag point bears some similarity to that originated by Silverman and refined by Grauer and Hamilton for measuring the liquidus temperatures of glasses.

The basic equipment consists of a temperature gradient furnace and a platinum specimen holder. The platinum holder is 6 inches long with supports for the fibers spaced approximately ½ inch apart.

The furnace is essentially the same as that described by Grauer and Hamilton except that the heating coils are of Nichrome rather than platinum wire.

A specimen is drawn in the form of a fiber, 0.5 to 0.8 mm in diameter. Suitable fibers can be prepared by drawing from the lip of the crucible in which the glass was melted. This is a convenient method of obtaining fibers directly from the melt, even in those cases where the glasses devitrify readily. The specimen is placed lengthwise on the holder and the holder is inserted into the core of the furnace. After 25 min. the holder is withdrawn. If the furnace has been properly adjusted, that section of the fiber that was in the hotter region will have sagged between the supports, whereas the section of fiber that remained in the cooler region will not have sagged. The temperature at the first compartment, measured from the open end of the furnace, in which the glass sagged between the supports is the temperature of the sag point.

The furnace is properly adjusted when the sag point occurs in the linear gradient region of the temperature distribution curve. A probe thermocouple is then inserted into the furnace up to this sag point distance and the temperature is measured.

Following the above procedure, the sag point is defined as the temperature at which a fiber, 0.5 to 0.8 mm in diameter, horizontally supported at half-inch intervals, will sag under its own weight in 25 ±5 minutes.

Significant information may be obtained in the process of determining the sag point as to the feasibility of cooling sizeable melts of new compositions to form glasses. In considering the problem of the glass-forming possibilities of a melt of a new composition, one is interested

not only in whether the melt will cool as a glass, but whether glass will form in sufficiently large quantity so that sizeable articles can be fabricated from it. Once the glass has formed, one is further concerned if such articles can be annealed without danger of devitrifying. It is necessary to recall that the liquidus temperature is the temperature above which crystals cannot form. The temperature of maximum rate of crystal growth is usually 50 to 100°C below the liquidus temperature. This region of maximum crystal growth is of the greatest concern in the practical problem of cooling a melt to glass. As the temperature is decreased below this region, the rate of crystal growth decreases rapidly because the increased viscosity associated with lower temperatures counteracts the tendency toward crystal growth. For practical purposes, this rate becomes zero at sufficiently low temperatures. Many compositions that will form glasses in small quantities, or when the melt is poured on a cold plate, will devitrify to a considerable extent when an attempt is made to make these same compositions in larger quantities for melts of about 500 g or more, because the center of the cooling piece must remain at temperatures in this region of maximum crystal growth for considerable periods of time. Thus, when specifying whether a particular composition will form a glass, the experimental conditions under which glass formation occurs must be specified.

In the technique of determining the sag point, a portion of the specimen is usually held in the temperature region where crystal growth may occur. The presence of crystals on withdrawal from the furnace, and their relation to the sag point, gives an indication of the tendency of the particular glass to devitrify in this critical region. As a consequence, the feasibility of cooling large melts of a given composition as glass can be predicted.

The one extreme would be a specimen that emerges without the sag point having developed, and yet shows the presence of crystals along the section that was in the hotter region of the furnace. Such a composition would present the least favorable condition for glass formation. The opposite, and most favorable condition for glass formation, would be a specimen that emerges with a well-defined sag point and shows no evidence of crystallization anywhere along the fiber.

The fact that crystals do not form in the temperature region above the sag point does not necessarily indicate that the temperature of maximum crystallization is higher than the hottest portion of the specimen. It may indicate that the rate of crystallization is so slow that crystals do not form in the time that the fiber was in the furnace. This shows that the melt can be held for considerable time in this dangerous region with little fear of devitrification.

In general the difficulty of glass formation increases as crystals appear closer to the sag point. If crystals form on the cold side of the sag point, it indicates that even if glasses are formed, the problem of crystallization during the process of annealing would still remain.

If a glass crystallizes in the annealing temperature range, the difficulties involved are not necessarily insurmountable. Fused silica, for instance, crystallizes in the annealing region, the crystal growth being initiated at the surface. It would appear, however, that if the criterion suggested by this procedure, and by what has been said before, is adopted, then fused silica is far from being the ideal glass it is frequently described to be. If a glass is regarded as the opposite of a crystal, then those glasses that devitrify least readily come closest to being "ideal" from a theoretical as well as a practical point of view. Thus, glasses that contain "network modifiers" and "intermediates" in addition to the so-called basic silica network, but which crystallize fairly slowly in the region of maximum crystal growth, come closer to being "ideal" than does pure silica. On the other hand, pure B_2O_3 can be crystallized only with the greatest difficulty and is more nearly an ideal glass in spite of certain (usually) undesirable properties (i. e., high hygroscopicity, low melting point, high coefficient of expansion).

The sag point is not offered to replace either the deformation or the softening point. The deformation point is obtained from the determination of the thermal expansion by the interferometric method and is part of the data that are essential to establishing the correct temperature to use for the fine annealing of optical glasses. The sag point is determined in a matter of minutes as compared with a day or more for the deformation point, and can be used to establish a maximum temperature for the comparable annealing of experimental glasses. The temperature of the sag point is nearer to the annealing range than is the softening point and hence devitrification troubles encountered in the latter determination are avoided.

CORNING TO GIVE MATERIALS COURSE FOR AIRCRAFT, MISSILES ENGINEERS

A one week course on glass and ceramic materials for aircraft and missile engineers will be given, without charge, by Corning Glass Works beginning May 12.

The program, sponsored by the company's New Products Division, will be given in Houghton Park, the Administration and Research and Development Center of Corning Glass Works, at Corning, New York.

"We are offering the course," says the new products division manager John B. Ward, "to create greater knowledge and better understanding of the increasing number of glasses and ceramics being designed into current and future aircraft and missiles."

A major part of the course will be devoted to the fundamentals of glass and ceramic technology—the properties, mechanical measuring and testing, and structural application of glass and ceramics.

Several sessions will consider Pyroceram, the newly developed family of glass-ceramic materials announced by Corning last year. Now in commercial production, Pyroceram was originally developed for missile radomes. The inventor of Pyroceram, Dr. S. Donald Stookey, manager of Corning's Fundamental Chemical Research Department, will conduct several of the sessions on the new super-strength ceramic made from glass.

Members of the company's Research and Development Division and Ceramic Research Division will conduct the course on a technical level. Included will be general sessions, round-table discussions and demonstrations. There will be tours of Corning's research laboratories and glassmaking plants.

Current Statistical Position of Glass

Employment and payrolls: Employment in the glass industry during February, 1958 was as follows: *Flat Glass:* A preliminary figure of 25,700 given for February, 1958 indicates a decrease of 7.4 per cent from the adjusted 27,700 reported for January, 1958. *Glass and Glassware, Pressed and Blown:* An increase of .5 per cent is shown by the preliminary figure of 75,200 reported for February, 1958, when compared with the adjusted figure of 74,800 recorded for January, 1958. *Glass Products Made of Purchased Glass:* The preliminary figure of 12,100 given for February, 1958 indicates a decrease of 3.2 per cent from the previous month's adjusted figure of 12,500.

Payrolls in the glass industry during February, 1958 were as follows: *Flat Glass:* A decrease of 12.7 per cent is shown in the preliminary $12,261,640.39 given for February, when compared with January, 1958's adjusted $14,053,621.87. *Glass and Glassware, Pressed and Blown:* A slight decrease of .2 per cent is shown in the preliminary $27,494,513.21 reported for February, 1958, when compared with the previous month's adjusted $27,545,972.92. *Glass Products Made of Purchased Glass:* A preliminary figure of $3,606,087.25 was reported for February, 1958. This is a decrease of 3.4 per cent when compared with the adjusted figure of $3,732,879.50 recorded for January, 1958.

Glass container production: Production based on figures released by the Bureau of the Census, Industry Division, was 12,216,000 gross during March, 1958. This is an increase of 12.1 per cent over the previous month's production figure, 10,899,000 gross. During March, 1957, glass container production was 12,808,000 gross or 4.6 per cent above the March, 1958 figure. At the end of the first three months of 1958, glass container manufacturers have produced a preliminary total of 34,829,000 gross. This is 2.5 per cent below the 35,738,000 gross produced during the same period in 1957.

Shipments of glass containers during March, 1958 came to 11,258,000 gross, or an increase of 4.5 per cent above February, 1958 shipments, which were 10,771,000 gross. Shipments during March, 1957 amounted to 11,390,000 gross or 1.2 per cent above March, 1958. At the end of the first three months of 1958, shipments have reached a preliminary total of 32,908,000 gross, which is 3.8 per cent over the 31,690,000 gross shipped during the same period in the previous year.

Stocks on hand at the end of March, 1958 came to 19,132,000 gross. This is 5.1 per cent above the 18,196,000 gross on hand at the end of February, 1958, and 8.9 per cent higher than the 17,570,000 gross on hand at the end of March, 1957.

GLASS CONTAINER SHIPMENTS

(All Figures in Gross)

Narrow Neck Containers

	Mar., 1958
Food	996,000
Medicinal and Health Supplies	1,426,000
Chemical, Household and Industrial	760,000
Toiletries and Cosmetics	840,000
Beverage, Returnable	706,000
Beverage, Non-Returnable	82,000
Beer, Returnable	229,000
Beer, Non-Returnable	626,000
Liquor	816,000
Wine	379,000
Sub-total (Narrow)	6,860,000

Wide Mouth Containers

Food	*3,133,000
Medicinal and Health Supplies	350,000
Chemical, Household and Industrial	172,000
Toiletries and Cosmetics	313,000
Packers' Tumblers	48,000
Dairy Products	139,000
Sub-total (Wide)	4,155,000
Total Domestic	11,015,000
Export Shipments	243,000
TOTAL SHIPMENTS	*1,258,000

*This figure includes Fruit Jars and Jelly Glasses.

GLASS CONTAINER PRODUCTION AND INVENTORY

(All Figures in Gross)

		Production Mar., 1958	Stocks Mar., 1958
Food, Medicinal and Health Supplies; Chemical, Household and Industrial; Toiletries and Cosmetics	Narrow Neck	4,530,000	7,904,000
	Wide Mouth	*4,348,000	*6,173,000
Beverage, Returnable		951,000	1,828,000
Beverage, Non-Returnable		94,000	224,000
Beer, Returnable		256,000	499,000
Beer, Non-Returnable		630,000	893,000
Liquor		841,000	1,317,000
Wine		351,000	680,000
Packers' Tumblers		60,000	108,000
Dairy Products		155,000	316,000
TOTAL		*12,216,000	*19,132,000

*This figure includes Fruit Jars and Jelly Glasses.

NORELCO DIFFRACTION SCHOOL TO BE HELD IN CHICAGO

The thirtieth Norelco X-ray Diffraction School for chemists, metallurgists, physicists, production supervisors, quality control engineers and others interested in rapid, accurate methods of analysis, will be held at the Edgewater Beach Hotel, Chicago, during the week of June 2-6, 1958.

Registration for the week-long course will be limited to 125 for the first four days and to 150 on Friday, the day devoted to actual application problems when guest speakers deal with current methods used in modern plants. There is no registration fee.

Monday through Thursday, the sessions involve extensive classroom and laboratory work wherein participants discuss their own problems and become familiar with the use of all types of equipment. Basic subjects covered by prominent educators and scientists include X-ray diffraction, diffractometry and spectrography.

H. R. LILLIE AND W. W. SHAVER ADVANCED AT CORNING

Two organization changes in the Research and Development Division of Corning Glass Works were announced recently by Dr. William H. Armistead, company vice president and director of research and development.

Howard R. Lillie has been named to the newly created position of staff research manager.

Dr. William W. Shaver will succeed Mr. Lillie as manager of the fundamental physical research department. Dr. Shaver will incorporate within the group his current atomic energy research.

H. R. Lillie

W. W. Shaver

Mr. Lillie joined the company in 1927 as a research physicist. He holds seven patents, mostly in the field of glass tempering, and is the author of many technical articles in that field.

A graduate of Allegheny College, Mr. Lillie received a master's degree from the University of Wisconsin in 1926. He is past president and a Fellow of the American Ceramic Society, a Fellow of the Society of Glass Technology in England, a member of the Society of Rheology and a member of the executive committee of the International Commission on Glass.

Dr. Shaver has been associated with the company since 1924 and has served successively in the insulation division, the physical laboratory and as manager of product development. He also has published many scientific papers and holds 26 patents in the field of glass technology.

Dr. Shaver received a doctorate from the University of Toronto and served there as a research assistant prior to joining Corning. He is a Fellow of both the American Ceramic Society and Society of Glass Technology, a member of the atomic energy section of the American Institute of Chemical Engineers and a member of the American Physical Society and the Institute of Radio Engineers.

HEAVY MINERALS APPOINTS DISTRIBUTOR

It has been announced that the Heavy Minerals Company of Chattanooga, Tennessee, has appointed Whittaker, Clark & Daniels, Inc. 260 West Broadway, New York 13, N. Y. as distributors of their cerium oxide, polishing grade and their rare earth cerium polishing compound.

Whittaker, Clark & Daniels as manufacturers, exporters and importers of non-metallic minerals, pumice, rouges, pigments and colors, has the background and sales force, it is felt, to give good service and coverage for the continental United States, Canada, and export, which their distributorship covers.

By owning their own raw material sources, Heavy Minerals Company can tailor their production to fit the customers' needs with the assurance of a uniform product at all times.

Whittaker, Clark & Daniels' wide coverage of the fields of plate glass, mirror, optical, television tube, lens and cut glass polishing fields, together with the fact that they have warehouse stocks, will put them in position to give the same service on these two products that they have given for over seventy-five years with other merchandise.

PITTSBURGH PLATE NAMES TWO TO FIBER GLASS POSTS

Appointment of James D. Doughty as manager of quality control for the fiber glass division of Pittsburgh Plate Glass Company has been announced by John K. Cochran, manager of production, fiber glass division.

Prior to his appointment Mr. Doughty was associated with the company's glass division's statistical quality control department during the past six years. A native of Torrance, California, Mr. Doughty joined Pittsburgh Plate's Mt. Vernon, Ohio, window glass plant in 1942. He is a graduate of Ohio State University and a member of the American Society for Quality Control.

Also announced was the appointment of William J. Miller to the fiber glass division's production department. Mr. Miller is temporarily assigned to the company's Pittsburgh general office and will transfer later to Shelby, North Carolina, where he will be in charge of purchasing upon completion of the multi-million dollar fiber glass plant. Mr. Miller is a native of Harwood, Pennsylvania, and more recently had been associated with the International Latex Corporation.

OLIN MATHIESON DIVISION COMPLETES DENSE SODA ASH FACILITIES

Completion of new facilities at Saltville, Va., to produce and store dense soda ash was recently announced by John O. Logan, vice president and general manager of the Industrial Chemicals division, Olin Mathieson Chemical Corporation.

The construction program, underway 15 months, costs more than $1,000,000.

Mr. Logan said the addition of dense soda ash at the Saltville plant is to meet current and future needs of the glass industry, which annually consumes some 1,800,000 tons. He said the plant will continue its regular production of light soda ash.

"This additional producing point will result in better service to our customers through shorter shipping times," Mr. Logan said. Formerly, much of the dense soda ash used in the area was shipped from the division's Lake Charles, La., plant.

Saltville is the birthplace of the Mathieson Corporation, one of the predecessor companies of Olin Mathieson. The company's original plant was built there in 1894. The present Saltville plant, in addition to soda ash, makes caustic soda, chlorine, fused alkalis, dry ice and bicarbonate of soda.

New Equipment and Supplies

SPECTROGRAPH USED AS CONTROL

Baird-Atomic, Inc., 33 University Road, Cambridge 38, Mass., has manufactured a research spectrograph which can be used as a production control instrument with the attachment of an interchangeable direct reading instrument. This attachment is said to permit the company's spectrograph to be used for routine control as well as research studies.

This attachment combined with the spectrograph is said to provide fast, accurate dial-readout-analyses on routine samples, while allowing for rapid changeover to the unlimited range possible with spectrography. The direct reading attachment presents, as per cent concentration, readout of eight elements in less than two minutes with precision and freedom from human error and compensates for environmental variations.

ELEVATING CONVEYORS

VFC Division, Automation Devices, Inc., Erie, Pa. has announced a new line of elevating conveyors. The basic design is vertical to save floor space with floor level loading to avoid high lift hopper filling. This permits the gentler handling of parts.

The outlet door in bin is adjustable to control the flow of parts to the conveyor belt. The design of the conveyor's self-cleaning cleats practically eliminates slow downs due to snarling or nesting of parts. Conveyor is equipped with a 'paddle' type of relay switch arm which automatically starts and stops to deliver only the quantity of parts required in the feeder bowl.

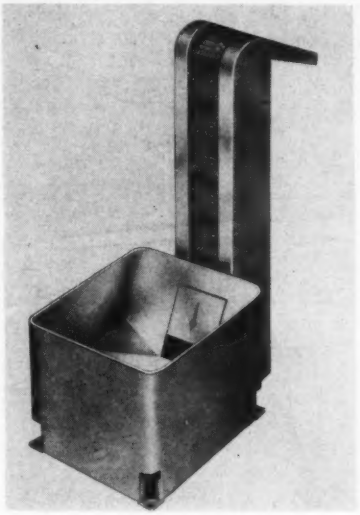
The hopper capacity is approximately five cubic feet and has drilled footings for securing and leveling. The bin is formed of 3/16 inch plate with a reinforced top ring for durability against industrial truck loading.

HIGH STRENGTH ALLOY FOR LEHR BELTS

Cambridge Wire Cloth Company, Cambridge, Maryland, announces a new low-cost alloy for glassware annealing belts that is said to exhibit extremely high strength and resistance to heat in operation. The product, Nealloy, has a yield point at least 1½ times greater and an endurance limit about 50 per cent greater than that of carbon steel.

This new alloy was formulated for use in the moderately high temperatures of modern lehrs operating at approximately 1100° F., and was designed to carry heavy loads at high speeds. It has been in the development stage for three years and has been subjected to severe field tests.

PORTABLE ELEVATOR



The Hamilton Tool Company, Ninth Street at Hanover, Hamilton, Ohio, has manufactured a portable elevator which can be used as a variable height loading dock. The company claims two advantages over other loading methods: the device maintains constant level with trucks beds, eliminating ramps and permitting rapid and safe use of fork trucks; also, it may be positioned and removed from position by overhead crane, so that a railroad siding may also be used for truck loading. The platform is 10 by 12 feet exclusive of extensions. The load capacity is 10 tons and the lift speed is 13 inches per minute.

NEW SURFACE PYROMETER

The Pyrometer Instrument Company, Inc., Bergenfield, N. J., has developed a new pyrometer with surface and subsurface ranges designed for use in either plant or laboratory. The indicator has two scale ranges in different colors: the low range from 0-500° F. is drawn in black; the high range, 0-1500° F. is calibrated in red. Temperature readings, it is claimed, can be interpolated to within a fine fraction of each division. The range selector switch permits the operator to change from one scale to the other with ease.

The meter is said to correct itself automatically for changes in room temperature on both scales and to assure an accuracy 1½ per cent. It is enclosed in a dust, moisture and shock resistant shielded housing. The pyrometer, model DR35, is available with a selection of 15 different types of interchangeable thermocouples and flexible and rigid extension arms.

NEW FIBER GLASS BONDING AGENT

New York Quinine & Chemical Works, Division S. B. Penick & Company, 50 Church Street, New York 8. N. Y., has begun semi-commercial manufacture of a new fiber glass finishing agent. Used to prepare the surface of glass fiber so that a better bond is established between these fibers and polyester, epoxy, melamine and phenolic resins, NOL-24 is reported to increase greatly the wet and dry strength properties of these laminates.

The agent was developed by Dr. Porter Erickson and Irving Silver of the Naval Ordnance Laboratory in Silver Spring, Md., and is said to be the closest approach yet to the "universal finish." Commercial and experimental quantities of the product are now available.

CATALOGS RECEIVED

Anderson Physical Laboratories, 609 South Sixth Street, Champaign, Ill., has prepared a bulletin to announce the publication of an extensive near infrared spectra. The bulletin, which is free upon request to the company, describes and illustrates the service. A complete library of spectra may be obtained on a subscription or individual basis. The spectra, covering all classes of organic and some inorganic compounds in the 0.7 to 3.2 micron range, wil be made available to all spectroscopists.

The Refractories Institute, First National Bank Building, Pittsburgh 22. Pa., announces the publication of a Product Directory of the Refractories Industry in the United States, 1958 edition. This volume lists 2700 brands of refractories produced by 185 refractory manufacturers. The Directory is cross indexed for ready reference, by companies, plant locations, product divisions and brand names.

Copies of the Directory may be secured by writing to the Institute.

Ansul Chemical Company, Chemical Products Department, Marinette, Wisc., has issued a 15-page 2-color booklet on sulfur dioxide. The publication discusses the chemical at length and gives information on questions asked most often by manufacturers and research chemists during the 40 years that the company has been making liquid sulfur dioxide.

Included in the subject matter are the physical and chemical properties of sulfur dioxide, specifications and specification test methods, suggested uses, toxicity, shipping and handling procedures. The booklet is one of a series on the company's industrial chemicals and may be obtained without charge.

DONALD E. SHARP, OF LOF, DIES

Dr. Donald E. Sharp, internationally known glass technologist, who joined Libbey-Owens-Ford Glass Company 15 years ago as assistant director of research to organize a glass technology section and since 1955 was vice chairman of its permanent technical policy committee, died March 29 in Toledo Hospital following a stroke.

Memorial services were held in St. Paul's Episcopal church, Maumee, Ohio, on April 1, in the presence of many of his associates, neighbors and friends. For several years Dr. Sharp had been a member of the vestry of St. Paul's and was serving as its treasurer in recent years.

Interment was in Hamburg, N. Y., where he spent 20 years of his earlier business life, was active in several companies, served as president of the board of education, and where he was married to Harriet Evelyn Minkel in 1921.

D. E. Sharp

Born in Corning, N. Y., on October 30, 1896, Dr. Sharp was literally close to the glass industry all his life. He attended the Corning Free Academy and was graduated from Northside High School, Corning. Later he studied at Carnegie Institute of Technology and at the University of Wisconsin, majoring in physics. His first job in the glass industry was as an assistant to Dr. J. T. Littleton, then chief physicist of Corning Glass Works, where he came in contact with many celebrities in glass technology.

After service with the ceramic department of the Bureau of Standards in Pittsburgh in World War I, Dr. Sharp served for a few years as assistant to Dr. G. W. Morey at the optical glass plant of the Spencer Lens Company, Hamburg, N. Y. Later he became manager of the plant and produced there the first large telescope disc ever to be made in the United States. It was a 40-inch piece of glass which became the eye of the telescope for the Stewart Observatory at Tucson, Arizona. He was associated with Walter Rising in this project. Subsequently, Dr. Sharp purchased the factory. An association with James Bailey developed out of these operations. In 1937 the Hartford Empire Company acquired Bailey & Sharp Co., and both principals moved to Hartford, Conn. It was in 1943 that Dr. Sharp left Hartford to Join Libbey-Owens-Ford.

He has to his credit many patents as diverse as lenses, glass feeders, and glass compositions. He is internationally known for contributions to glass technology, particularly in the correlation of the physical properties of glass with composition and applications of combustion engineering to glass manufacture. He has written more than 40 technical articles. Several of the most important deal with fuel utilization and evaluation of the performance of continuous glass melting tank furnaces.

During his professional career, Dr. Sharp had received many awards and honors. He was a fellow of both the American Ceramic Society and the British Society of Glass Technology, an emeritus member of the American Optical Society and of the American Physical Society, and long-time member of the American Chemical Society. He was a member of the Deutsche Glastechnische Gesellschaft. He received the honorary degree of Professional Ceramic Engineer from New York State College of Ceramics, Alfred University, in 1942 and Doctor of Science from Lafayette College, Easton, Pa., in 1952. In January 1957 he was awarded the Toledo Glass and Ceramic Award for distinguished service in glass technology.

Dr. Sharp was a member of the Toledo club, the Rockwell Trout club and Northern Light lodge, F & AM, Maumee, Ohio.

He had served as a member of the advisory committee of the Silicate Institute of the University of Toledo since its creation in 1952. In his home city of Maumee he was a member of the elected group which drafted the city charter and currently was serving as a health commissioner.

He had a lifelong interest in music and was an accomplished 'cellist.

Dr. Sharp leaves his widow; a sister, Miss Dorothy Sharp, 158 Pine Street, Corning, N. Y., and a brother, Norman Sharp, Allinard Park, Pa. The family residence is at 308 East Dudley Street, Maumee, Ohio.

LOF TECHNICAL CENTER TO EXPAND

Emphasis on engineering, research and development by Libbey-Owens-Ford Glass Company has placed expansion of facilities at the LOF Technical Center in Toledo high on the list of new projects for 1958.

Two new modern glass curtain wall buildings and a complete new entrance rotunda will nearly double the Technical facilities, which serve manufacturing plants in five states, it was revealed in the annual report recently issued to shareholders.

A two-story and basement Engineering wing will be the largest of the new Technical Center constructions. It will house drafting areas for Furnace, General Services and Maintenance sections on the first floor and Mechanical and Structural sections on the second floor.

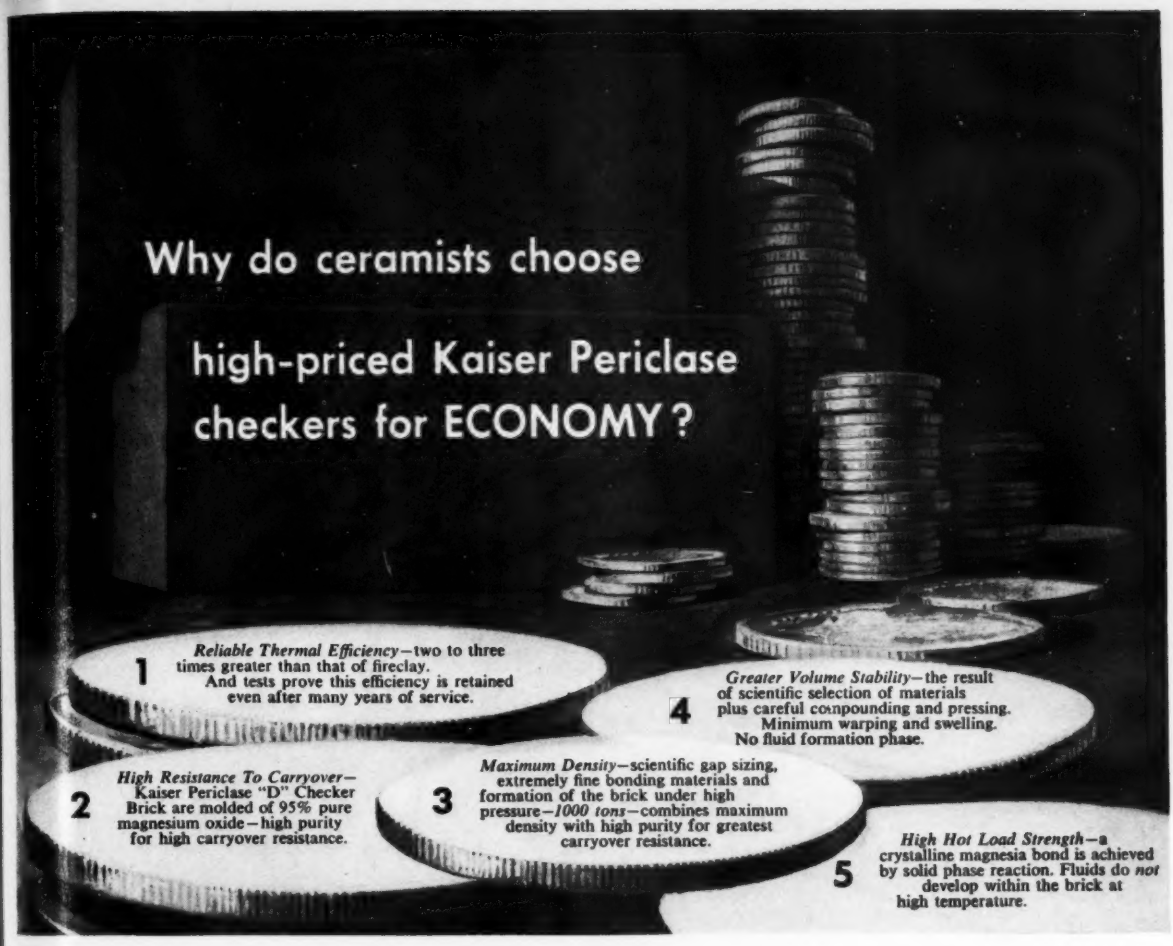
A one-story Administration wing will provide offices for all principal technical executives, the permanent Technical Policy committee, Conference room, Library, Cafeteria and telephone equipment.

This is the third major expansion of Libbey-Owens-Ford technical facilities in 20 years. Ample area for future enlargement of the new wings is provided.

BOOK REVIEW

Compilation of ASTM Standards on Glass and Glass Products (C-14). This compact book is of interest and service to technologists, purchasing agents, and engineers concerned with the production and use of glass products contains 38 standards. Of these 7 are new, revised, or have had their status changed recently. This 1957 compilation supersedes the prior 1955 edition.

Among the general fields covered are, glass and glass containers, glass block and insulation, glass insulators, glass textiles, and electrical tests. 146 pages, 6 x 9, paper cover, American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., $2.50.


Why do ceramists choose
high-priced Kaiser Periclase
checkers for ECONOMY?
1 Reliable Thermal Efficiency—two to three times greater than that of fireclay. And tests prove this efficiency is retained even after many years of service.
2 High Resistance To Carryover—Kaiser Periclase "D" Checker Brick are molded of 95% pure magnesium oxide—high purity for high carryover resistance.
3 Maximum Density—scientific gap sizing, extremely fine bonding materials and formation of the brick under high pressure—1000 tons—combines maximum density with high purity for greatest carryover resistance.
4 Greater Volume Stability—the result of scientific selection of materials plus careful compounding and pressing. Minimum warping and swelling. No fluid formation phase.
5 High Hot Load Strength—a crystalline magnesia bond is achieved by solid phase reaction. Fluids do not develop within the brick at high temperature.

Although ceramists are generally agreed that Kaiser Periclase "D" Brick are the best-performing checker brick available, one additional fact must still be faced: *Kaiser brick are probably the highest-priced checker brick you can buy.*

Where, then, is the economy?

The only possible answer, of course, is that the bricks' performance properties *must make a whopping big difference* in furnace results. They do!

Thermal Efficiency Saved $82,000 In Fuel

Take for example the first property listed: "Reliable Thermal Efficiency" (the ability to hold heat and conduct heat). Here are figures from an actual comparison:

	Campaign "A" Fireclay; token use of basic brick	Campaign "B" Extensive use of basic brick
Life—Operating days	720	1,038
Pull—Total tons of glass melted	70,348	109,423
Average tons of glass per operating day	97.8	105.4
Total tons of glass per square foot of melting area during campaign	100.6	156.3
Square feet of melting area per ton per day	7.16	6.64
Average fuel consumption, cubic feet of gas per ton of glass produced	10,967	8,662

The fuel consumption in campaign "A" increased from 9342 cubic feet at the start to a high of 11,600 during the latter part of the campaign (figures from months having same average glass production rates).

In campaign "B," the regenerative cycle was shortened from 20 to 15 minutes to take advantage of the higher thermal efficiency of the basic brick . . . *and gas consumption remained an almost constant 8662 cubic feet throughout the nearly three years of the campaign!*

The plant saved 2305 cubic feet of gas per ton of glass produced as compared to campaign "A"—resulting in a saving of 74.9 cents per ton, or a total saving of $82,000 on fuel over the three-year campaign. Management gives almost full credit to the checker setting.

Performance Boosts Production, Cuts Down Time

Yet, fuel saving is only part of the story. Huge additional savings and profits can properly be credited to the performance of Kaiser Periclase checkers . . . greater production per square foot of hearth . . . longer campaign life.

These bricks have consistently served in continuous glass container furnace campaigns that have lasted up to four years —campaigns terminated due to failure of other refractories.

For supporting data on how the superior characteristics of Kaiser Periclase brick can increase the efficiency of your operation, ask for our booklet, "A Report on a Better Basic Brick for the Glass Industry."

Call or write Kaiser Chemicals Division, Dept. G-8113, Kaiser Aluminum & Chemical Sales, Inc., at any of the Regional Offices listed below:
PITTSBURGH 22, PA. . . . . 3 Gateway Center
HAMMOND, IND. . . . . 518 Calumet Building
OAKLAND 12, CALIF. . . . . 1924 Broadway

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OF SOMONAUK, ILLINOIS

Announces

its DEBUT in the GLASS INDUSTRY MARKET

- 21 Grades St. Peter Silica
- 6 Grades Silica Flour
- SiO_2 99.9%
- Fe_2O_3 0.015%

UNMATCHED
Purity and Whiteness

Write for our *FREE* booklet "May We Serve You" for complete details on our SUPERIOR PRODUCT TODAY!

F. H. ADAMS, SURFACE COMBUSTION, DIES

Frank H. Adams, President of Surface Combustion Corporation, Toledo, Ohio, passed away on Easter Sunday, April 6, 1958.

Mr. Adams was a leader who freely gave his time and energy to a multitude of civic organizations and projects. He was rewarded with acknowledgment and success through his work as guiding leader of Surface Combustion Corporation and many trade organizations.

F. H. Adams

Mr. Adams was born in Lamar, Mo., March 28, 1886 and graduated from the University of Missouri with a degree in civil engineering in 1908. In 1912 he started his career as project engineer in the Henry L. Doherty organization. When, in 1923, the Combustion Utilities Corporation, a gas research subsidiary of the Doherty organization was founded in New York, he was elected vice president and treasurer.

In 1924 H. L. Doherty bought Surface Combustion in New York. Frank Adams was appointed its first treasurer and elected vice president and general manager in 1926.

Surface Combustion Corporation moved to Toledo in 1927. Mr. Adams became president in 1941.

Frank Adams held many positions of prominence in the gas equipment industry. He was president of the Industrial Furnace Manufacturers in 1929-30 and of the Gas Appliance and Equipment Manufacturers in 1939-40.

He was a charter member of the Institute of Gas Technology, formed in Chicago in 1939, and served for a number of years on the executive committee of that research organization.

Mr. Adams served on the national board of the American Gas Association from 1937 to 1940, and in 1945 was elected head of AGA's manufacturers' section. AGA honored Mr. Adams as a "pioneer" in development of the industrial gas industry in 1953.

Besides being president of Surface Combustion Corporation, Mr. Adams was a director of Toledo Trust Company, Toledo Pipe Threading Machine Company and Webster Engineering Company of Tulsa.

J. E. BURRELL MADE GENERAL MANAGER AT COLUMBIA-SOUTHERN

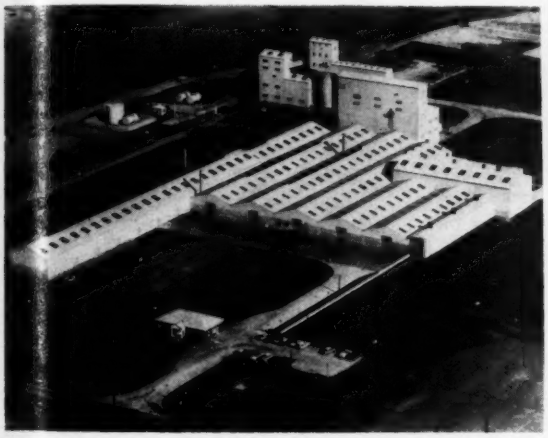
Appointment of J. Earl Burrell as general manager of operations for Columbia-Southern Chemical Corporation was recently announced by Joseph A. Neubauer, president.

Mr. Burrell succeeds the late Robert L. Hutchison who served as vice president in charge of operations. Prior to his appointment as general manager of operations, Mr. Burrell served as assistant to the vice president in charge of operations.

He joined Columbia-Southern at Barberton, Ohio, as a research and development engineer in 1941 upon graduation from the University of Michigan.

HARBISON-WALKER OPENS NEW REFRACTORIES PLANT AT HAMMOND

The newest Harbison-Walker Refractories Company addition to refractory production capacity is a basic refractories plant at Hammond, Indiana. The plant site, in addition to satisfying the needs of the steel industry, is said to have many other desirable features. It can serve industry in the Chicago and mid-west areas through rail, truck or water shipments. It is located on the Chicago, South Shore and South Bend Railway within limits of the Chicago switching area. The plant is on a major district artery adjacent to the interstate toll road system, within a short distance of the freeway. With frontage on the Grand Calumet River, the plant is well located for water transportation. Further, the site is adequate for future expansion.



Aerial view of new Hammond, Indiana basic refractories plant.

The same facilities will serve to bring the required raw materials to the plant. Among the materials will be a very pure periclase, which the company produces in a newly built plant at Ludington, Michigan.

The company's own engineering department handled design, engineering, and supervision of construction. Consolidated Engineering Company, Inc., of Baltimore, Maryland served as general contractor. The new plant incorporates new concepts and improvements in equipment and layout. Mechanical and electrical controls have been installed wherever possible to improve efficiency and working conditions.

Construction of the plant began in May, 1956; production of refractories has been under way since late in 1957. The Hammond Works is the fifth basic refractory plant built by Harbison-Walker in the last decade.

Fifty years ago, the company produced less than 20 refractory products; today nearly 100 types and classes are produced. High alumina brick, super-duty silica brick and basic brick, it is claimed, are becoming increasingly more important. The company and its subsidiaries operate 39 plants and more than 40 mines and quarries in 17 states and in Canada, including California, Washington, Colorado, Arkansas, Pennsylvania, Maryland, Ohio, Kentucky, New Jersey, North Carolina, Indiana, Missouri, Alabama, Georgia, Texas, Michigan.

Milestones in Glass Progress

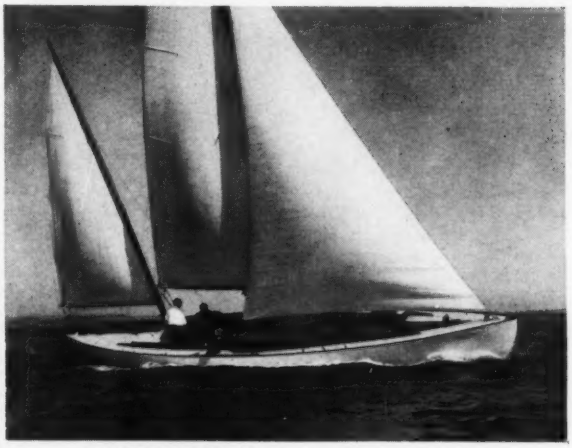
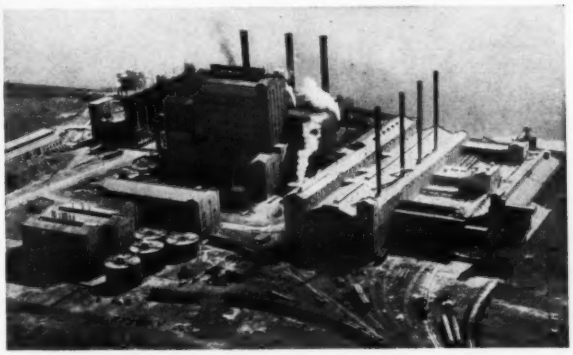


PHOTO COURTESY OWENS-CORNING FIBERGLAS CORPORATION

1943 Combining fibrous glass with plastic creates products with many advantages: permanent color, ease of forming, outstanding structural properties. Large, one-piece products (boat hull, above) can be manufactured in a single forming operation. Reinforced plastics are tough and light in weight; have superior weathering resistance.



1890 Michigan Alkali Company, now a division of Wyandotte Chemicals Corporation (North Plant Process, above), was founded by Captain J. B. Ford to supply Soda Ash to the glass industry. Over the years, Wyandotte has maintained its position as a major producer of Soda Ash. Today, it is a working partner, supplying technical assistance and raw-material chemicals to those great companies marking milestones in glass progress.

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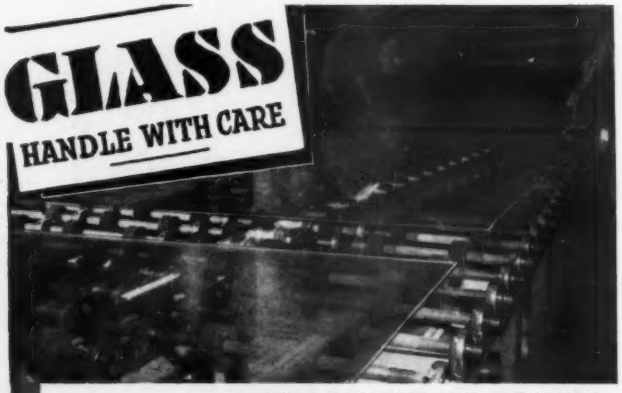

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FIFTH INTERNATIONAL CONGRESS ON GLASS

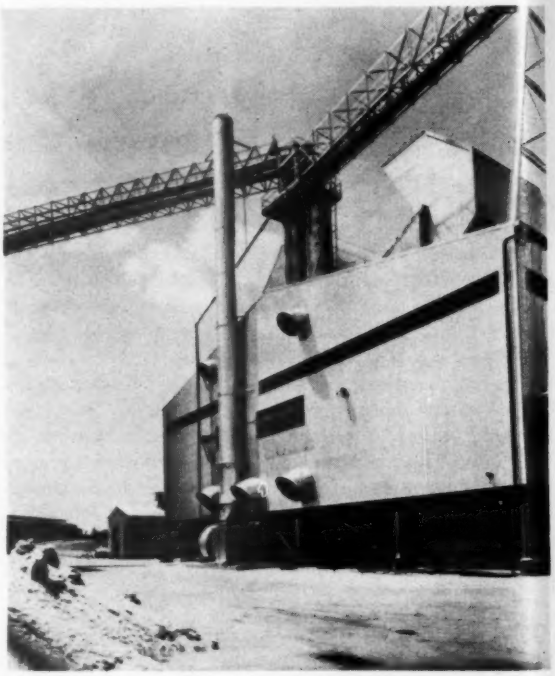
According to invitations of the Deutsche Glastechnische Gesellschaft and the Bundesverband Glasindustrie, the International Commission on Glass will hold the Fifth International Congress on Glass in Munich (Germany), from June 29th until July 4th, 1959.

At the Congress there will be reports and discussions on scientific as well as technical questions concerning glass, as has been the custom at previous meetings. Social gatherings will give those in attendance the opportunity for further contacts with one another.

The program for the Congress will be made up in the course of the year and will be sent to all glass technologists and other friends of the glass industry in various countries a few months before the beginning of the Congress.

Further information may be obtained at the secretary's office of the Congress at Frankfurt (Main), Bockenheimer Landstrasse 126.

• Frederic O. Hess, president, Selas Corporation of America, Dresher, Pa., announces the establishment of a District Office at 1901 W. 8th Street, Los Angeles 57, California. This will be the headquarters for sales representatives Stuart A. Whitehurst and Raymond J. Kenard, Jr., who will represent Selas in California, Utah, Arizona and Nevada.



This new corrosion resistant wrought iron smokestack guards against premature maintenance expense from accelerated oxidation created by high temperatures of conventional flu gases at Owens-Illinois Glass Company's modern plant at Atlanta, Georgia. The 75-ft. high by 3-ft. diameter stack installation is fabricated of 1/4-inch to 3/16-inch thick wrought iron plate. Identical protection against corrosion damage is provided at this plant in the breeching and oil tank, downspouts, and in cooling water and return lines piping applications. Stack fabrication was by J. J. Finnegan Company, Atlanta, with Standard Engineering Company of East Point, installers.

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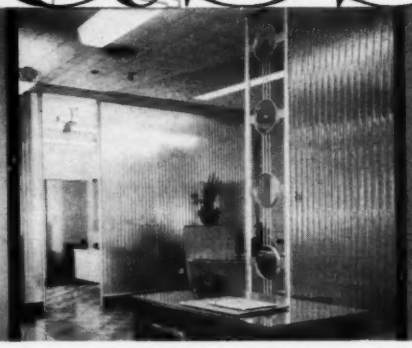

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FMC CREATES NEW OPERATING UNITS

Food Machinery and Chemical Corporation has created two new operating chemical departments and enlarged its executive committee in a move to streamline the organization in its chemical operations, it was announced by Dr. Carl F. Prutton, executive vice president.

The new operating units are the FMC Organic Chemicals Department and the FMC Inorganic Chemicals Department. The first includes the Niagara Chemical Division and the Chemicals and Plastics Division, formerly the Organic Chemicals Division. The second comprises the Becco Chemical Division, the Westvaco Chlor-Alkali Division, and the Westvaco Mineral Products Division.

Alfred T. Loeffler, FMC vice president, is named general manager of the new Organic Chemicals Department. He will be assisted by R. H. F. Dade, who has been named a vice president of the Chemical Divisions. General manager of the new Inorganic Chemicals Department is Frederick A. Gilbert, who was previously manager of Becco Chemical Division and Westvaco Chlor-Alkali Division. Donald C. Oskin will be assistant general manager under Mr. Gilbert, and has been named a vice president of the Chemical Divisions.

The new division manager of the Westvaco Chlor-Alkali Division is Robert J. DeLargey. He was formerly assistant division manager. Raymond F. Moran becomes manager of the Westvaco Mineral Products Division.

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B. T. HUGGLER TO MANAGE NEW KNOX PLANT

Ben T. Huggler has been appointed manager of Knox Glass Incorporated's new $3,000,000 plant which is being built at Danielson, Connecticut, according to Howard E. Steele, manager of manufacturing for the nation's fourth largest maker of glass containers. The company, with headquarters at Knox, Pa., now operates seven plants in Pennsylvania, Indiana, Mississippi and Texas.

B. T. Huggler

Currently manager of the company's Marienville, Pennsylvania, plant, Mr. Huggler is a quarter-century veteran of the glass container manufacturing industry. He will take over his new duties some time in June, following completion of the preliminary construction and prior to installation of the furnace, glass-forming machines and lehrs. The plant is scheduled to be in full operation by late summer or early fall of this year.

He began his career with KGI in the early 1930's working in the warehouse at Marienville. He later studied accounting and went into the office as a clerk-accountant before becoming office manager. After obtaining valuable experience in scheduling production he served as assistant plant manager for several years before being appointed manager in December, 1953.

A native of Taylor, Pa., Mr. Huggler is married to the former Audrey Carter of Marienville. They have two daughters.

KAISER CHEMICALS EXPANDS REFRACTORY RESEARCH

Research facilities at the Milpitas, California, laboratories of the Kaiser Chemicals Division of Kaiser Aluminum & Chemical Corporation have been expanded to permit consolidation of the division's basic refractory and magnesia research activities.

Frank M. Cashin, vice president and general manager of the division, said the step is part of a new program to organize research into several cooperating sections, each of which will be interested primarily in the special needs of one of the major refractory-consuming industries.

The new program will be directed by James C. Hicks, who has been appointed director of research for the division, with headquarters in Oakland. Mr. Hicks formerly was director of refractories research at Milpitas.

Under the program, a team of scientists and technicians will concentrate on the special refractory problems and requirements of different fields, including the glass industry.

Mr. Hicks, who joined the Kaiser organization in 1943, has spent 14 years in refractories research. He was appointed manager of technical services for refractory research in 1949 and has served as director of refractory research since 1953. He received mining engineering degrees from Idaho University and Columbia.

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SODA ASH
SODIUM SULFATE
BORAX · HYDRATED LIME

Russian Translations . . .

(*Continued from page* 278)

rubber block down weighs 300 grams. All dimensions are in millimeters.

Before the glass surface passes under the resistance wire, it is cleaned from the abrasive by the rubber squeegees 9.

The instrument affords values correct to about 1°C. It detects, for instance, the cooling of glass surface caused by the addition of a new portion of abrasive.

NEW NBS PUBLICATION

Methods of Testing Thermocouples and Thermocouple Materials, by Wm. R. Roeser and S. T. Lonberger, National Bureau of Standards Circular 590, issued February 6, 1958.

This publication describes methods of testing thermocouples and thermocouple materials, and points out certain precautions that must be observed if reliable results are to be obtained. The measurement and control of temperature are essential to a uniformly high quality of product, and recognition of this fact by various industries in recent years has led to a tremendous increase in the use of temperature-measuring equipment. By far the greater portion of such measurements, in the higher temperature range, is made with thermocouples.

The circular mainly considers calibration of platinum versus platinum-rhodium, copper-constantan, Chromel-Alumel, and iron-constantan thermocouples, and some guidance is provided in the selection of a test method best adapted to a given set of conditions. One section discusses calibration at freezing points, melting points, and boiling points, while another chapter covers calibration by comparison methods. The accuracies obtained in calibrating the various types of thermocouples by different methods, and the uncertainty in the interpolated values by various methods are presented in a table.

The publication has 21 pages; 20 cents. Order from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Foreign remittances must be in U. S. exchange and should include an additional one-fourth of the publication price to cover mailing costs.

ALLIED CHEMICAL BUILDS HYDROFLUORIC ACID PLANT

Plans to build a hydrofluoric acid plant at Nitro, W. Va., have been announced by I. H. Fooshee, president, Allied Chemical's General Chemical Division. Construction has already begun.

Fooshee said the new facility will supply the metal and other industries in the area as well as atomic energy requirements. Both aqueous and anhydrous forms of the acid will be produced at the location.

The Division, which is the nation's primary producer of hydrofluoric acid, has other installations at Marcus Hook, Pa., and Baton Rouge, La. Its Canadian affiliate, The Nichols Chemical Co., Ltd., recently completed construction of Canada's first hydrofluoric acid facility at Valleyfield, Que.

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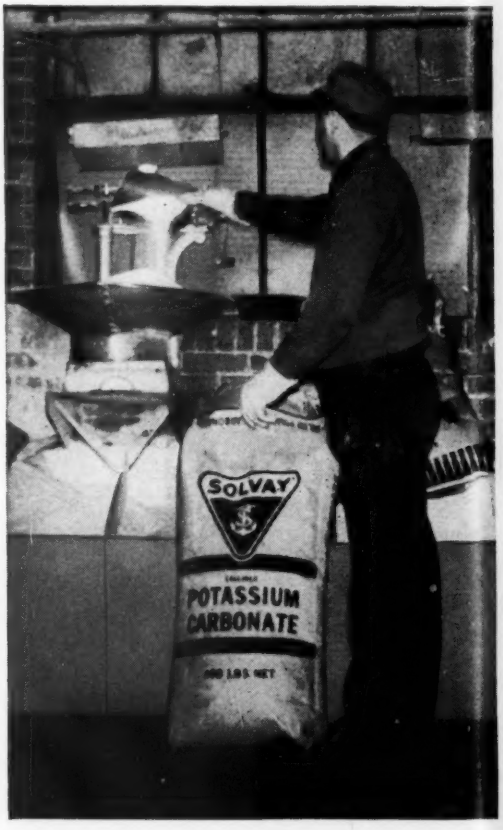

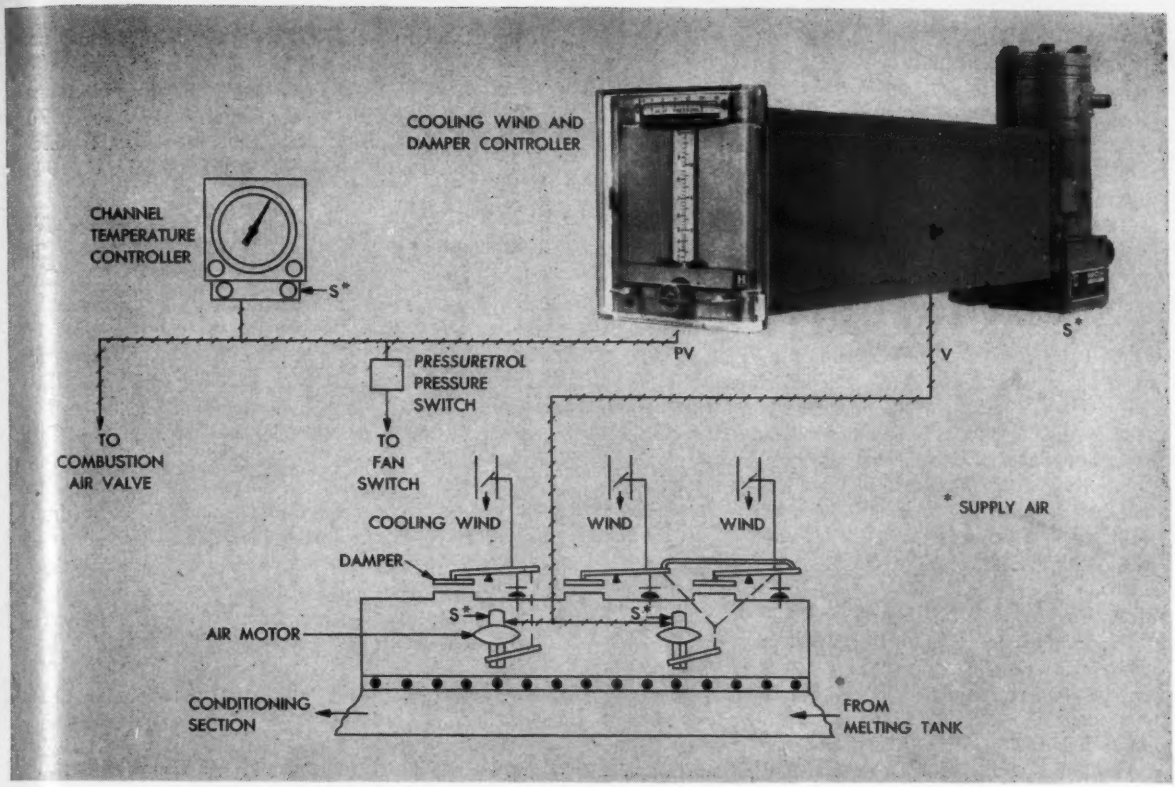

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When the limits of the cooling wind adjustment have been reached, heating control will continue to change the fuel supply to maintain desired glass temperature. The *Tel-O-Set* controller permits manual cooling wind operation from the panel during startup. After startup, control can be transferred bumplessly to automatic operation.

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*Trademark, Minneapolis-Honeywell

Honeywell

H HONEYWELL *First in Controls*

Inventions . . .
(*Continued from page* 282)

Miscellaneous Processes

Manufacture of Hollow Blocks of Glass. Patent No. 2,772,515. Filed June 13, 1952. Issued December 4, 1956. Three sheets of drawings; none reproduced. Assigned to Pilkington Brothers Limited by John Dennett.

This invention relates to the manufacture of hollow blocks of glass.

Each half block is molded in one of a pair of molds which are hinged together on a common axis and which during molding lie flat. A gob is fed to each mold and a head with plungers then descends on to the molds to press out the two half blocks. The head is then retracted and the molds immediately tilted up, like closing a book, so that the soft rims of the freshly molded half blocks are brought together with sufficient pressure to cause welding.

In order to avoid sagging of the upper walls of the half blocks when the latter are in a vertical position, a similar operation to that already described is carried out, in which the molds are moved round through 90° so that a corner of each half block is near to the hinge instead of having two sides parallel to the hinge.

The period of time during which the encompassed gases exude past the uppermost parts of the half blocks may be precisely regulated by slowing down of the movement, that is to say, during the last 5° movement of each of the half blocks to vertical position.

The atmosphere immediately above the tilted up half blocks may be heated so that the descent of relatively cold atmospheric air into the cavity encompassed by the half blocks during the final steps of egress of the enclosed gaseous volume is prevented.

There were 13 claims and the following references cited in this patent: 419,441, Henning, Jan. 14, 1890; 1,315,983, O'Neill, Sept. 16, 1919; 2,164,093, Soubier, June 27, 1939; and 2,353,532, Williams, July 11, 1944.

Method of Producing Cellulated Articles. Patent No. 2,775,524. Filed March 21, 1952. Issued December 25, 1956. No drawings. Assigned to Pittsburgh Corning Corporation by Dominic D'Eustachio.

In accordance with the present invention a more efficient method of utilizing carbon in the process for making cellular glass has been discovered. This method comprises employing carbon or carbonaceous material as a coating on an inert substance having a high surface area for a given weight, for example having a surface area above 10 square meters per gram of inert substance and preferably above 50 square meters per gram of inert substance. Such high surface area substances are inert with respect to the glass and gassing agents and include diatomaceous earth and specially prepared substances having a high surface area such as specially prepared silicas and calcium silicates.

The carbon may be prepared by absorbing on the diatomaceous earth or silica a solution of sugar or other carbon-containing substance, which substance will readily decompose to carbon upon heating or treating with a reducing agent. Other carbon containing compounds which may be used include glycerol or other polyhydric alcohols. The weight ratio of carbon to inert substance may vary from 5 to 50 parts carbon in 100 parts inert substance.

A sufficient quantity, for example from 0.2 to 0.8 percent by weight of this prepared diatomaceous earth or silica is added to the ground glass, mixed and pulverized in a ball mill and then heated to a temperature sufficient to sinter and cellulate the glass as described above to produce the cellulated glass. Temperatures of from 1400 to 1800° F. are suitable in most instances. A high degree of cellulation is obtained by this process and less than one-half the amount of carbon previously required is used. Cellulated products thus produced are more resistant to moisture penetration than cellulated products produced according to presently known methods.

The silica skeleton of the diatomaceous earth keeps the carbon particles separated from each other. The use of such carbon-containing silica provides a greater volume of material for grinding with less carbon and enables a more efficient distribution of the carbon to be attained. The presence of the diatomaceous earth or silica in the product is not harmful.

There was one claim and the following references cited in this patent: 2,123,536, Long, July 12, 1938; 2,343,908, Kinzie et al., Mar. 14, 1944; 623,807, Great Britain, May 24, 1949; and 457,274, Canada, June 7, 1949.

Glass Laminate, Article and Method. Patent No. 2,778,758. Filed July 28, 1952. Issued Jan. 22, 1957. No drawings. Assigned to Bjorksten Research Laboratories, Inc. by James E. Henning.

(*Continued on page* 300)

THE
PENELECTRO
BUBBLER SYSTEM
FOR GLASS FURNACES

- *Improves Homogeneity*
- *Increases Output*
- *Lowers Seed Count*
- *Decreases Fuel Consumption*

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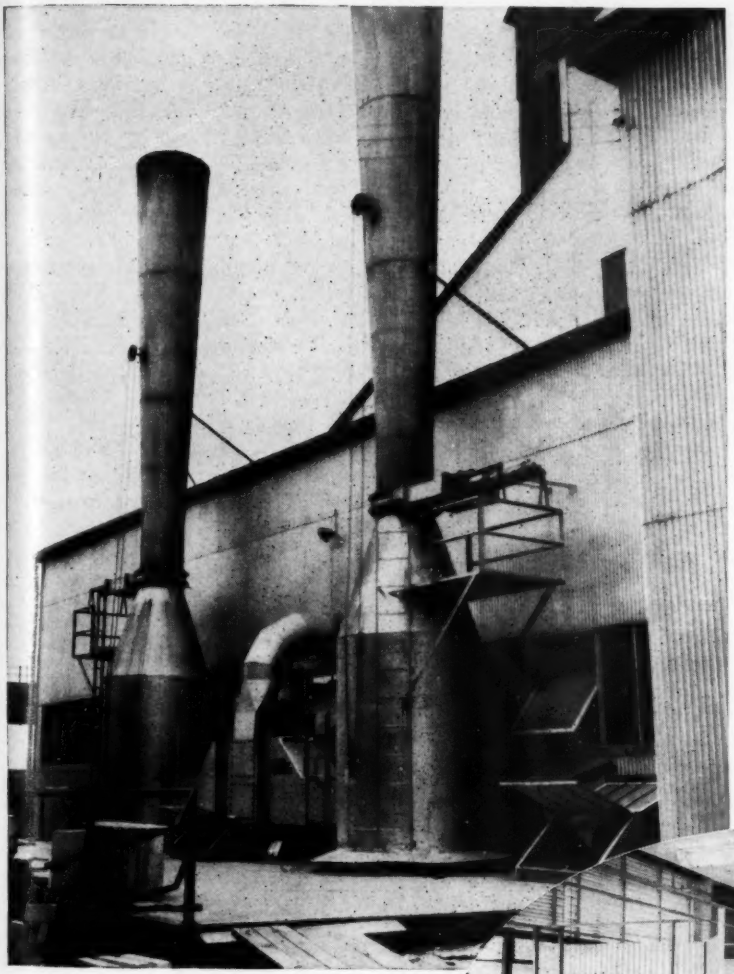
PRODUCTION UP- FUEL COST DOWN WITH MORGAN-ISLEY COMBUSTION CONTROLS



Morgan-Isley Ejector installation at Mississippi Glass Co., St. Louis, Mo., world's largest manufacturer of rollec glass. Inset shows one of Mississippi Glass products in use as office partitions.

In commenting on the Morgan-Isley installation at his company's St. Louis plant, Mr. Ellis Humphreys, Vice President of Mississippi Glass Co. said, "An ejector stack is far less temperamental than a natural draft stack, and, of course, is much less costly to build.

"One of the great advantages of the Morgan-Isley system comes from the secondary checkers. These give the incoming air a fine prewarming before it goes into the regular checkers. This not only results in better furnace operation, but seems to keep the regular checkers in much better condition. Incidentally, the secondary checkers seem to last indefinitely, and don't need to be cleaned during repairs. This system is good and greatly improves furnace operation."

MORGAN WORCESTER

ROLLING MILLS - MORGOIL BEARINGS
WIRE MILLS - GAS PRODUCERS - EJECTORS
REGENERATIVE FURNACE CONTROL

CCC48

MORGAN CONSTRUCTION COMPANY • Worcester, Massachusetts

Inventions . . .

(*Continued from page* 298)

This invention relates to means for adhering fluoro polymers to glass and more particularly for adhering polytetrahalo ethylene to glass, or to any other substance having oxygen or hydroxy groups chemically present at the surface.

In accordance with the invention, a reaction product is prepared of a halogenated alkanol containing more than one halogen atom per molecule, such as for example, trichloro tertiary butyl alcohol, dichloro sec. butyl alcohol, diodo fluoro tertiary amyl alcohol, tribromo butyl alcohol, and the like, with a compound such as titanium tetrachloride, by mixing these ingredients in a ratio between from 1 to 90 parts of one of the ingredients with 90 to 1 parts of the other. These reaction products may be prepared in any common organic solvent which is inert to the metal halide. The reaction product thus prepared is applied to a glass surface or a surface of a metal which is capable of forming an oxide layer adjacent to its immediate surface, such as for example, aluminum, magnesium, chromium, steel, tin, and the like. The surface is then washed with water to remove hydrolyzable halogen which tends to improve the adhesion.

The invention is further illustrated by the following specific example:

35.5 grams of trichloro tertiary butanol were dissolved in 35 grams of xylol, and were then added to 38 grams of titanium tetrachloride, also dissolved in 38 grams of xylol. Addition was made slowly with stirring. After a period of 40 minutes the mixture was diluted to 200 cc. with xylol and after stirring was applied to the surface of the glass to which it was desired to bond the fluorinated resin.

The glass was then soaked 30 minutes in water and was dried by rubbing with a dry cloth. Sheets of dried glass treated as above were then placed on each side of a sheet of poly trifluoro chloroethylene and were pressed together for about 20 minutes at 240° C. at a pressure of 100 p.s. i. The resultant sandwich was strong and was perforated by a clean, round hole, without shattering or delamination, on shooting at temperatures from 0 to +300° F.

There were 4 claims and the following references cited in this patent: 2,484,484, Berry, July 6, 1948; 2,456,262, Fields, Dec. 14, 1948; 2,495,286, Brubaker, Jan. 24, 1950; 2,502,286; Sowa, Mar. 28, 1950; 2,539,329, Sanders, Jan. 23, 1951; 2,566,365, Pedlow et al., Sept. 4, 1951; and 612,125, Great Britain, Nov. 9, 1948.

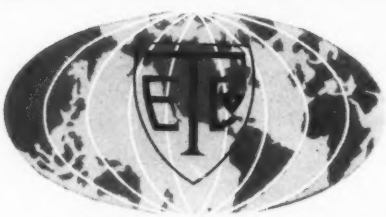
Making a Glass Article of High Mechanical Strength. Patent No. 2,779,136. Filed July 6, 1955. Issued January 29, 1957. No sheets of drawings. Assigned to Corning Glass Works by Harrison P. Hood and Stanley Stookey.

This invention relates to the production of glass articles having high mechanical strength by providing them with a stress of substantially uniform compression in the surface and parallel therewith.

The method comprises forming an article of glass containing 45 per cent to 80 per cent SiO_2 and 7 per

(*Continued on page* 302)

In the glass center of the world



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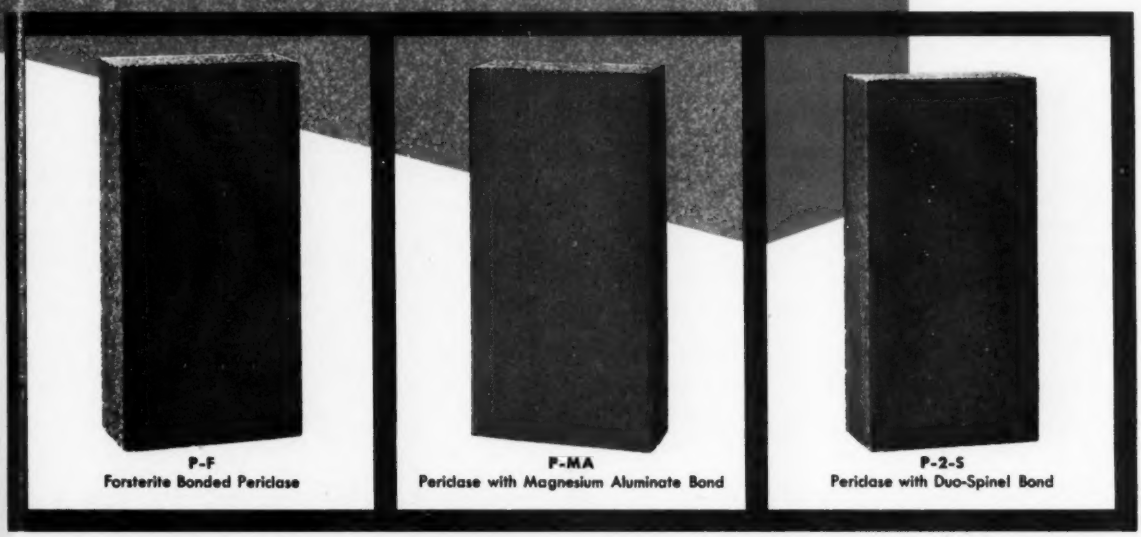
FOR THE GLASS INDUSTRY

Continued Progress in Basic Refractories by Harbison-Walker Research

THREE NEW COMPOSITIONS COMPLEMENTING FORSTERITE L



These new types embracing different combinations of physical and chemical properties are available for the requirements of various specific conditions which prevail in glass furnace regenerators. The range of chemical compositions provides for the greatest resistance to the wide diversity of corrosion factors and destructive regenerative cyclic effects. They are produced as hard burned brick for maximum stability of mineral constitution and as chemically bonded brick, particularly for the benefit of maximum spalling resistance. For certain wall and arch constructions, they are made with metal casings.

DURABILITY

Basic refractories are needed to withstand the most severe treatment imposed by present day practice in producing glass of the highest quality and operation at maximum furnace capacity. Durability of the checker setting and resistance to clogging are paramount. In the development of these unusual basic refractories, provisions are made for best withstanding all the various destructive factors. Fluxing by dust carry-over including basic constituents and excessive amounts of silica, volatile alkalies and the effects of gas atmospheres are of major importance in the selection of the basic brick which can be used with greatest benefit.

EFFICIENCY

The inherent properties of specific heat, density and thermal conductivity which govern heat capacities are closely similar in these basic brick. Their high resistance to wetting accounts for the avoidance of excessive build-up resulting in clogging and to the formation of a glaze which can reflect heat and detract from heat absorption. Long service life without interruption for premature maintenance repairs, obviously contributes to overall efficiency.

Write for further information regarding the complete range of compositions and physical properties of Harbison-Walker basic refractories, best suited for all operating conditions.

World's Most Complete Refractories Service

HARBISON-WALKER REFRACTORIES CO.

AND SUBSIDIARIES GENERAL OFFICES: PITTSBURGH 22, PA.

Inventions . . .

(*Continued from page* 300)

cent to 25 per cent of at least one of the alkali metal oxides of Na_2O and K_2O, contacting the article while at a temperature above its strain point but below its softening point with a lithium salt which will be molten but which will not decompose objectionably at such temperature, and maintaining the article in contact with the salt at said temperature for a time sufficient to permit lithium ions to diffuse into the surface of the glass in exchange for alkali metal ions of glass.

The weight of lithium thus introduced into the glass, computed as Li_2O is approximately one half the weight of the displaced Na_2O plus one third the weight of the displaced K_2O. It has been found that, as a result of such displacement and diminution in the weight percentage of alkali metal oxide in the glass, the thermal expansion coefficient of the portion of the glass in which such exchange has occurred is less than its original thermal expansion coefficient and, therefore, less than that of the glass in which such exchange has not occurred. Since the ion exchange is progressive in character and moves inward from the surface, the glass article is thus provided with a surface layer having a lower thermal expansion coefficient than its interior.

There were 15 claims and the following references cited in this patent: 2,428,600, Williams, Oct. 7, 1947; also Williams and Weyl "Surface Dealkalization of Finished Glassware", THE GLASS INDUSTRY, *26*, June 1945.

Method and Apparatus for Forming Surface Films. Patent No. 2,779,690. Filed June 30, 1950. Issued Jan. 29, 1957. One sheet of drawings; none reproduced. Assigned to Libbey-Owens-Ford Glass Company by Romey A. Gaiser.

The invention relates broadly to surface films or coatings and more particularly to an improved method and apparatus for the application of films or coatings to smooth, finished surfaces of relatively hard materials such as glass or plastics.

For example, when a sheet of glass is first heated and then sprayed with titanium tetrachloride vapors, a very thin, colorless and transparent film, having a number of valuable properties, is formed on the exposed surfaces of the glass sheet. The film is quite stable so far as ordinary usage is concerned. It is high reflecting, and in addition, is evenly wettable with water in the first instance, but non-wettable after washing and drying.

Because of these characteristics, such films are readily adaptable to a large number of uses, both in the glass and plastic fields. For example, they can be applied to opaque glass or transparent plastics, and methyl methacrylate polymers and polyvinyl butyral plastics can be used to produce mirrors for automobiles and aircraft. When formed on transparent glass surfaces, a transparent or one-way mirror results, and on transparent glass tableware, they serve to enhance both the beauty and utility of the pieces. When applied to plastics of the types mentioned many light weight non-breakable items having good optical qualities are produced.

Another object of the invention is the provision of apparatus embodying a spray gun nozzle wherein dry air carrying the vapors of a hydrolyzable, volatile chloride is internally mixed with moist air and externally heated, the resulting product being emitted to produce a uniform film or coating upon the selected surface.

There were 5 claims and 16 references cited in this patent.

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S. R. MILLIKEN JOINS FOOTE RESEARCH GROUP

Dr. Spencer R. Milliken has been appointed research and development-sales staff coordinator by Dr. E. M. Kipp, director of research, Foote Mineral Company. Dr. Milliken joins Foote after five years with the Aluminum Company of America Research Laboratories in New Kensington, Pa.

A graduate of Georgia Institute of Technology, Dr. Milliken received his M.S. in physical chemistry from Emory University in 1951 and his doctor's degree from the Pennsylvania State University in 1954. He is a member of The American Chemical Society, The American Institute of Mining and Metallurgical Engineers and the New York Academy of Sciences.

• Lester J. Miller has been named executive vice-president of the A. P. Green Fire Brick Company, Mexico, Missouri. Announcement of Mr. Miller's election was made on behalf of the board of directors of the company by William S. Lowe, president.

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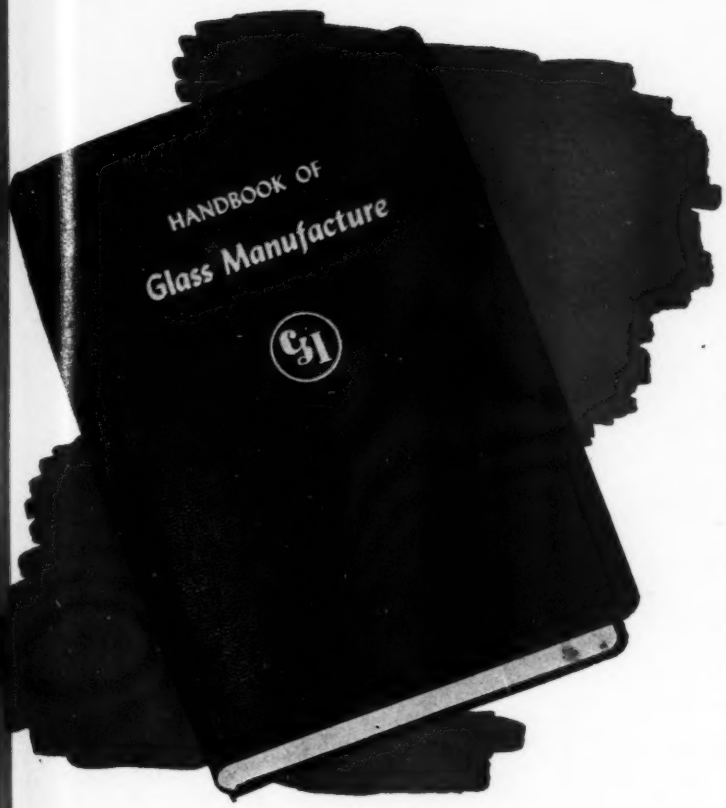

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